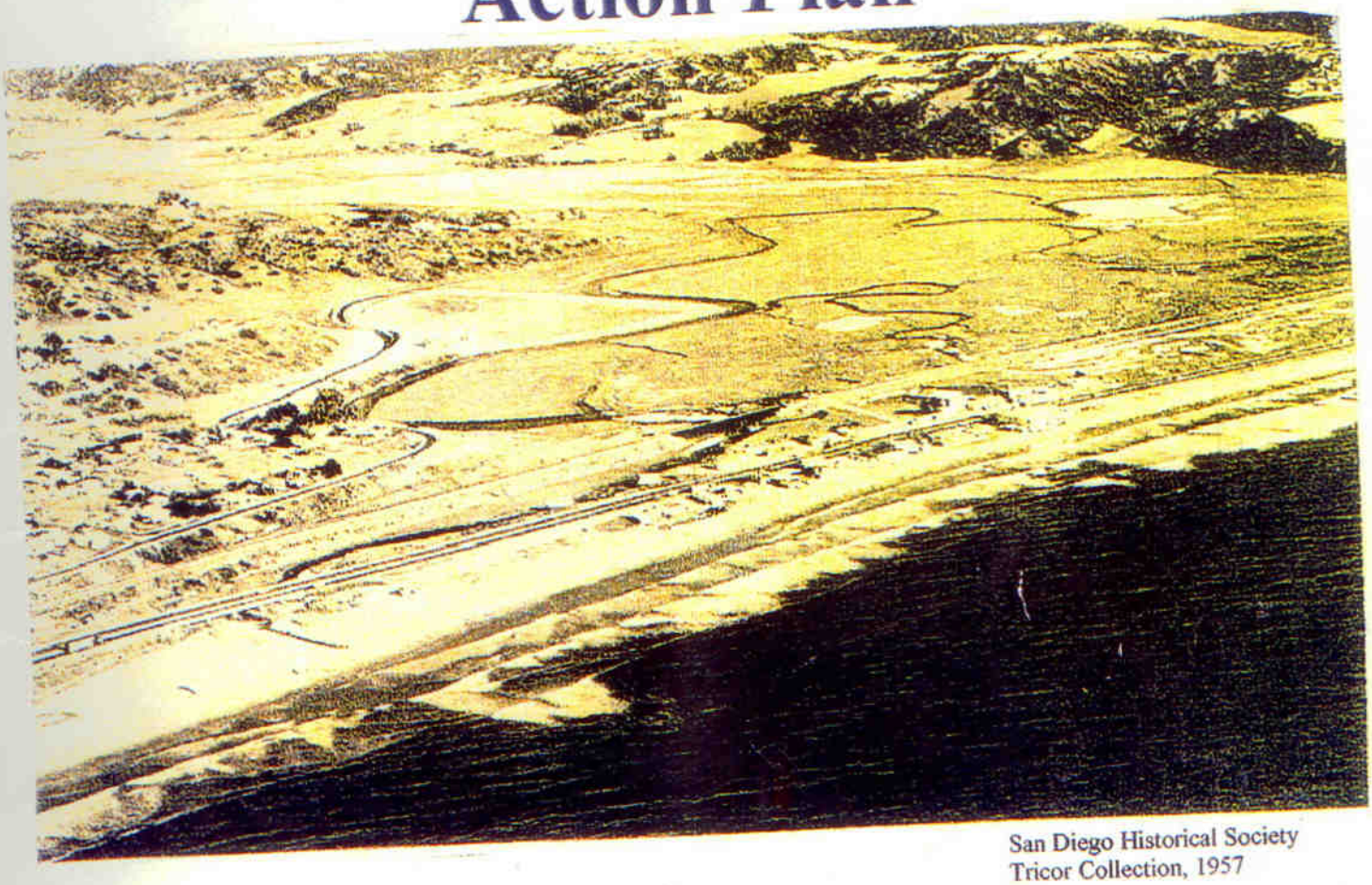
The San Elijo Lagoon Action Plan



San Diego Historical Society
Tricor Collection, 1957

Coastal Conservancy

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SAN ELIJO LAGOON CONSERVANCY

Preserving And Enhancing San Elijo Lagoon

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EXECUTIVE SUMMARY

1.0 INTRODUCTION

This report identifies the critical stakeholders whose participation is essential to enhancement of San Elijo Lagoon. It describes the degraded environmental conditions and problems that derive from chronic eutrophication, and the ecological improvements that accrue from tidal flushing. The report describes a proposed endowment structure, management plan, and procedures for establishing a mechanism for providing long term financial support for sustaining tidal flushing and implementing important environmental projects at San Elijo Lagoon. This report provides detailed descriptions of 25 specific Creation, Restoration, Enhancement, and Creation Projects that will significantly improve the biological productivity of San Elijo Lagoon

2.0 THE STAKEHOLDERS

1. Citizens who live, work and visit the San Elijo Lagoon, its watershed and adjacent areas.

2. The municipal, state, and federal government agencies that have some responsibility to the public for protection, management, and regulation of resources of San Elijo Lagoon include:

- U.S. Government
  - U.S. Fish & Wildlife Service
  - U.S. Army Corps of Engineers
- State Government
  - Department of Fish and Game
  - Water Resources Control Board
  - Coastal Commission
- County Government
  - San Diego Department of Parks and Recreation
- Local Government
  - City of Encinitas
  - City of Solana Beach
  - City of Escondido
  - Rancho Santa Fe

3. The San Elijo Lagoon Conservancy (SELC), a non-profit volunteer organization, is very concerned about the continuing degraded health of the lagoon, its lessened habitat value for wildlife, and the reduced value to the primary stakeholder - the citizenry. The San Elijo Lagoon Conservancy is willing (given financial and government agency support) to take on a larger role in the active management of this lagoon.

3.0 THE PROBELM

In order to sustain and enhance the biological productivity of San Elijo Lagoon (as supported by law and environmental policy) and to provide viable habitat for threatened and endangered species the ocean inlet must remain open to continuos tidal flushing. Without sustained tidal flushing San Elijo Lagoon cannot fulfill its mission as a sanctuary, breeding ground, food source, etc. for migratory birds and for coastal fisheries. Construction of highways and railroads, with the approval of governments, has created artificial barriers (literally and figuratively) to circulation and natural behavior of the lagoon. Today laws, public policy and public opinion all say that this biological degradation needs to be corrected. San Elijo Lagoon is currently the only lagoon in San Diego County without a formal support or natural mechanism to facilitate keeping its ocean inlet open to tidal flushing:

- Tijuana Estuary - Mouth is open year round
- Sweetwater Marsh - Mouth is open as part of San Diego Bay
- San Diego River - Mouth is open year round
- Mission Bay - Mouth is open year round
- Los Penasquitos Lagoon - Fee for building in watershed pays for mouth opening
- San Dieguito Lagoon - 22nd Agricultural District opens the mouth and SCE is funding a wetland restoration project
- Batiquitos Lagoon - Port of L.A. funded a wetland restoration project to keep mouth open
- Agua Hedionda Lagoon - SDG&E's Encina Power plant conducts maintenance dredging to keep the mouth open
- Buena Vista Lagoon - Is a freshwater lagoon closed to ocean circulation

3.0 THE SOLUTION

Money is needed now - but not a lot; given the significant public and environmental benefit to the primary stakeholders and the requirement to begin the redress of the current situation. The financial needs are as follows:

1. Maintain Tidal Flushing. Guarantee a base of $100,000 to $150,000 per year or the earnings from a $1.6 - 2 million "endowment fund", to maintain an open lagoon mouth.

Historically, the government/agencies have not stepped forward to provide these funds on a guaranteed basis. Instead they have responded when environmental crises have occurred. The San Elijo Lagoon Conservancy has established a small Endowment Fund and has approximately $200,000 to $250,000 in sight. While it may be acceptable, or even appropriate, for local volunteer organizations like the San Elijo Lagoon Conservancy to help fund lagoon management projects, government agencies (by law and policy) must also commit the necessary money to maintain this important wildlife resource for the benefit of all citizens.

The USF&WS has paid for a five year study of experimental inlet dredging in order to best determine the appropriate time and procedures for opening the lagoon. These experiments have allowed us to gather the scientific data needed to document the ecological benefits of keeping the lagoon open to tidal flushing.

San Diego County has supported the lagoon by providing park rangers (who wrote the SEL Enhancement Plan) and some emergency funding in 1997/1998 to open the inlet.

County supervisor Pam Slater recently proposed that the San Diego County Board of Supervisors allocate $250,000 to improving management of San Elijo Lagoon. An initial sum of $50,000 was approved at a recent Supervisors' meeting and a two-year grant of $100,000 per year ($200,000 total) is docketed for an upcoming meeting. These funds are designated to keep the lagoon mouth open for tidal flushing for the balance of 1998 and for the next two years.

2. Implement Enhancement, Restoration, and Creation Projects. Undertake environmental projects that add to the reserve to insure it receives sufficient support to sustain the health of the lagoon. Special projects are needed to enhance the structure and functioning of the lagoon, to lead to the restoration of the natural rhythm and habitats of the lagoon, and to eliminate "invasive exotic" (non-indigenous) flora and fauna. The proposed projects range from a few thousand dollars (e.g. removing exotic species) to $100,000 + (e.g. dredging new channels in the West, Central, and East basins) and should receive long term funding to be successful. The San Elijo Lagoon Conservancy is willing to supervise the implementation and monitoring of these projects.

3. Acquire Property. Significant funds are needed to acquire property to enable creation of a permanent "buffer" between the natural environment of the lagoon and wildlife corridors, and the disturbances resulting from increased urbanization and human uses. Although, state funds (e.g. Nature Conservancy, etc.) are occasionally available, commitment of designated unallocated environmental support funds by various government entities is urgently needed.

5.0 NATURAL TIDAL FLUSHING

In 1996 the lagoon mouth was open for ten months. Restored tidal flushing resulted in:

- New growth of saltmarsh plants throughout the Central Basin.
- Fish populations increased in species and abundance.
- Water quality stabilized, no wide fluctuations were seen in dissolved oxygen, salinity, or temperature.
- Mosquito and midge populations decreased throughout the lagoon.
- Beach remained open to the public for the entire period.

What happened when the mouth did not stay open - In 1997, the mouth was closed for 5 months:

- 140,000 fish were killed.
- Mosquito and midge populations increased.

- Dissolved oxygen, salinity, and temperature fluctuated greatly.
- Large algae bloom occurred due to high nutrient content of water.
- Beach had to be closed upon opening due to accumulation of coliform bacteria.

6.0 PROPOSAL

The San Elijo Lagoon Conservancy proposes the following:

- Meet the obligation to primary stakeholders.
- Use San Elijo Lagoon Conservancy to implement this action plan.
- Facilitate funding on a regular basis.
- Allocate extra funds when they become available to do projects and/or expand the lagoon.

ENDOWMENT STRUCTURE AND MANAGEMENT

1.0 INTRODUCTION

This section an endowment structure and management plan for providing long term financial support for sustaining tidal flushing. An example amount of $1,600,000.00 can generate a 10%-13% return (see investment procedures below). This is formulated on a conservative investment on the national average of the market over its (the markets) entire life. We used the return figure of 10% as our basis for estimating the initial amount needed to establish a lagoon maintenance fund.

At 10% this endowment level would create $160,000.00 per year in interest. The amount of money needed to keep the lagoon inlet open is around $80,000.00 to $110,000.00 per year.

1.1 NON-STRUCTURAL ALTERNATIVE PROJECT COST ESTIMATE

1. Conduct one large scale dredging per year (both West and East of Hwy 101 bridge) Equipment will consist of excavators, scrapers, front-end loaders, and possibly a small dredger. This will most likely take place in the spring between March and May.
   COST **$50K – $55K**

2. Conduct two small dredgings per year on west-side of Hwy 101 bridge. Equipment will consist of scrapers and front-end loaders.
   COST $25K @ 2 times = **$50K**

   TOTAL COST PER YEAR **$100K – $105K**

NOTE: Depending on the severity of winter storms, rain totals, and summer conditions, it may be necessary to do split up the two smaller dredging projects into 3 or 4 smaller projects. A lot depends on the winter storms, rain totals, and summer conditions.

The remainder of the funds—which should be between 50K-60K will be divided up as such:

10% of the interest return will go back into the fund to cover inflation -- **$160K x 10% = $16K**

There will be a monitoring program built into the cycle (this is part of our permit with the California Coastal Commission). The monitoring will consist of:

1. Hydrological channel surveys before and after each project
2. Year-round water quality testing, quarterly fish and macro invertebrate sampling. The scope of the biological monitoring will change over time (i.e. vegetation will be added

after a given time to track increase is saltmarsh plants and the decrease of brackish species in the saltmarsh area.

3. Annual report to Coastal Commission and other agencies.

COST 20K

The remainder of the interest (10K-20K) will be used as a cushion for a drop in interest rates or additional inlet maintenance costs.

A percentage will be kept by the San Elijo Lagoon Conservancy to cover the cost of the endowment. This is typically around 1%-2% per year (NOTE: This will only cover the costs incurred by managing the fund, such as financial service charges and not any of the Conservancy's normal operating costs). In summary, one of the primary goals of the San Elijo Lagoon Conservancy is to keep the inlet open as much as possible. This can be accomplished by the above referenced implementing the described dredging program.

The San Elijo Lagoon Conservancy currently has about 450K towards this program. The San Elijo Lagoon has also been chosen for the California Clearinghouse grant program and is expecting funds to go towards the endowment fund.

2.0 INVESTMENT MANAGEMENT AND PROCEDURES

The San Elijo Lagoon Conservancy has established an Endowment Fund primarily for implementing an inlet maintenance program in order to assure tidal flushing. It is anticipated that the endowment principal will grow over time and that any additional funds will be put back towards the initial principal. Future fundraising, grant writing, and mitigation project funding will be used to conduct additional habitat creation, restoration, enhancement, and preservation projects in the Reserve. Candiate projects are described in the attached Action Plan.

2.1 SELC FIDUCARY RESPONSIBILITY

The SELC Treasurer, elected from among SELC Board Members, serves as the Chief Financial Officer of the SELC. The Treasurer reviews the monthly financial statements and gives a monthly report to the SELC Board. All investment decisions are reviewed and approved by the SELC Board before being implemented by the Treasurer. The SELC has established a policy that requires approval of at least two officers of the SELC Board before any check over $1,000 may be written. The SELC utilizes the accounting services of an independent CPA for preparation of financial statements, reconciliation of accounts, and preparation of tax returns.

2.2 ENDOWMENT GOALS

In March, 1998, the SELC approved a Financial Asset Management Plan which set forth goals, policies, and guidelines for the establishment of the Endowment Fund. The Board also selected Fidelity Investments as its financial brokerage company, and set criteria for investment of the funds within its brokerage account.

2.3 INVESTMENT GOALS

The SELC determined that the endowment should represent a long term, ongoing commitment to **maintain and enhance the health of the Reserve's ecosystem indefinitely**. Endowment investments must then be viewed from a long-term perspective, with the objectives of growth of capital, safety of principal, and annual income.

Growth of Capital--Increasing the size of the endowment over time is necessary in order to counteract inflation and provide an investment pool large enough to fund ongoing lagoon maintenance as well as special enhancement projects. Target investment returns should well outpace the rate of inflation.

Safety of Principal--As public funds, the endowment should not be exposed to the possibility of significant reduction in value as a result of investment risk, although some fluctuations in value can be expected and can be weathered given the long term perspective of the endowment. The endowment portfolio should represent a conservative mix of investment alternatives without undue weighting toward any one-market segment.

Annual Income--The endowment must ultimately generate a target amount of income annually in order to meet anticipated lagoon maintenance expenses. A portion of the endowment portfolio should be selected so as to generate annual distributed income. Planned income is generally preferable to the sale of selected investments as a means of raising funds needed on a recurring basis, because it doesn't involve exposure to market timing risk. In summary, the goal for the endowment is to maximize annual return.

2.4 FIDELITY INVESTMENT/BROKERAGE ACCOUNT

The SELC has established an "Ultra Service Account" with Fidelity Investments to hold all Endowment Fund assets. Fidelity provides discount brokerage services, is the largest mutual fund company in the world, offers an extremely wide array of no-load investment options, offers full service money market accounts paying competitive interest rates, and has a full service office conveniently located in San Diego. Detailed written monthly statements of all investment activity and account balances are provided by Fidelity, with current account information available 24 hours a day through Fidelity's protected on-line service.

In addition to Endowment Fund investments, the SELC maintains its primary Money Market Checking Account and a Cash Reserves Account at Fidelity. These accounts contain all SELC administrative funds, as well as funds raised through specific grants for several ongoing capital improvement and lagoon maintenance projects.

2.5 ENDOWMENT FUND INVESTMENTS

The Endowment Fund at present contains approximately $110,000, invested in two funds.

Fidelity Asset Manager–Income ($70,000): This fund seeks a high level of current income by allocating its assets among stocks, bonds, short-term instruments and other investments. The fund also considers the potential for capital appreciation. Its average annual return has been 9.99% (5yr), 12.24% (3yr), and 12.41% (1yr). Over the six years since its inception it has average an annual return of 9.94%. As a balanced fund it has not realized the tremendous returns associated with pure stock funds over the last few years. On the other hand, it is better positioned to withstand any corrections which might materialize in the stock market in the months ahead, or take advantage of a strengthening bond market. With an emphasis on income, a portion of the fund's annual return is in the form of distributed dividends and interest. This provides a measure of assurance that the endowment will be generating some amount of annual income, independent of any short-term fluctuations in the share price of the fund.

Pax World ($40,000): This fund seeks long-term growth and income by investing in equities and bonds, using both economic and social criteria. Its average annual return has been 12.62% (5yr), 21.28% (3yr), and 25.12% (1yr). Over the 27 years since its inception it has averaged an annual return of 10.01%. Its portfolio is more heavily weighted in stock investments, as reflected in its higher average annual returns in recent years.

Cash Reserve Account: While no endowment fund capital is presently invested in Fidelity Cash Reserve, this account is available to hold future endowment fund contributions or earnings while longer term investment alternatives are being considered. Fidelity presently pays approximately 5.3% interest on Cash Reserve Account balances.

At present the SELC is attempting to build up the Endowment Fund and has elected to have all distributions of income from investments automatically reinvested. Once the endowment goal has been reached and/or dispersals of funds for expenses of lagoon maintenance are contemplated, it may be desirable to have some or all of the investment income automatically accumulating in the more liquid Cash Reserve Account.

The SELC has complete flexibility within its Fidelity account in selecting the specific type or mix of investment vehicles for investment of endowment funds. Buying, selling, or transferring mutual fund shares can generally be accomplished without the imposition of any fees. Should any agency, organization, or individual contributing funds to the endowment wish to stipulate specific criteria for the investment of those funds, the SELC would be able to comply. The SELC also has the ability to accept donations of common stock or mutual funds from individual donors, and hold or sell those assets through its Fidelity account.

ACTION PLAN FOR ENHANCEMENT OF SAN ELIJO LAGOON

1.0 INTRODUCTION

The biological resources of San Elijo Lagoon have been gradually deteriorating for many years due to the cumulative effects of hydrological and land use changes to the watershed, urbanization, increased sedimentation, sewage spills, poor water quality, growth of invasive species, and severely limited tidal flushing. In recent years, increased urbanization within the watershed has accelerated the intensity and complexity of environmental impacts on San Elijo Lagoon. As shown in Figure 1-1, San Elijo Lagoon is part of a relatively small, narrow watershed (77 mi^2), which also contains several reservoirs. Of the 25,000 to 30,000 tons/yr of sediment that enters the lagoon from the watershed, only about 10,000 tons/yr actually transit the lagoon and are discharged to the ocean (Soil Conservation Service 1993). As a result water quality conditions and many of the habitats within the lagoon have become degraded even though it is still a significant environment for migratory birds; several of which are federally recognized as endangered species. Fresh and brackish water marsh plant species have been encroaching from the East Basin into the Central Basin and are aggressively reducing circulation throughout the lagoon and are out competing the saltmarsh community. In summary, a substantial effort must now be made to actively manage the San Elijo Lagoon ecosystem.

The County of San Diego Department of Parks and Recreation and the California Coastal Conservancy are actively committed to enhancing this lagoon and recently completed an Enhancement Plan (1996). Recent experimentation with methods for sustaining tidal flushing by actively maintaining a tidal inlet have shown that renewed tidal exchange is key to recovery of the lagoon ecosystem and that it can yield dramatic environmental improvements!

The San Elijo Conservancy has fostered an atmosphere of public and agency cooperation. The result has been a substantial public interest and active participation in preserving the lagoon. Their overall goal has been to facilitate protection and enhancement of the structure and functions of the natural resources of San Elijo Lagoon and to promote public education.

The goal of this project is to develop a specific "plan of action" for enhancing San Elijo Lagoon by outlining a series of projects that will significantly increase the ecological productivity of the lagoon.

2.0 OBJECTIVES

1. Develop a set of candidate projects for enhancing San Elijo Lagoon.
2. Prepare a written action plan for each candidate project.
3. Estimate funding requirements to implement each project (not done for all projects).
4. Identify methods to monitor performance of each project.

Refer to hard copy
for 2 charts

5. Develop an overall enhancement strategy that prioritizes and integrates the proposed projects.
6. Develop a long-term environmental monitoring program for tracking the overall effectiveness of the enhancement program.

3.0 CANDIDATE CREATION, RESTORATION, ENHANCEMENT AND PRESERVATION PROJECTS

A master list of candidate projects was derived from a review of the recently completed San Elijo Lagoon Enhancement Plan (1996) and from discussions with local marine scientists and park rangers. Table 3-1 presents a total of 25 candidate projects. The proposed projects have been grouped into the following categories: Creation, Restoration, Enhancement and Preservation. A total of 3 Creation projects, 6 Restoration projects, 15 Enhancement projects, and 1 Preservation project are described. The proposed projects reflect the diversity of habitats that exist in the lagoon and the complexity of the environmental problems that exist there. The projects range from management of endangered species and removal of exotic vegetation to selected basin dredging, hydrological improvements, and creating new habitat. Some projects are one-time efforts while others may require several years of effort or may be an annual requirement. Some projects are located at single sites while others will require work at multiple locations throughout the lagoon. The projects are not presented in any order of priority. The majority are suitable for use in fulfilling mitigation requirements that may be associated with development projects that have been permitted elsewhere.

A second list of projects that support the primary list of projects is presented in Sec. 5.0. These projects are needed to fill critical data gaps or are needed to enable final design or regulatory approval of the primary field projects.

4.0 DESCRIPTION AND SCOPE OF RECOMMENDED PROJECTS.

This section presents a brief description and action plan for each candidate project given in Table 3-1. The general location of each project is shown in Figure 4-1 and by lagoon basin in Appendix 1. A more detailed set of project maps is given in Appendix 2. The acreage and dredge volumes associated with each project are summarized in Table 4-1. An overall temporal strategy that prioritizes implementation of each project or combination of projects, and integrates them spatially and over time, so that the results of the projects will make both hydrological and ecological sense is given in Table 4-2. The Estimated costs are given in Section 7.0. The description of each proposed project described below includes the following information:

- Purpose
- Objectives
- Approach
- Monitoring and Remediation

Table 3-1. Master List of Candidate projects to Restore San Elijo Lagoon

CREATION

1. Excavation of upland terrain and extension of tidal channels
2. Introduce eelgrass habitat
3. Introduce cordgrass habitat

RESTORATION

4. Restore tidal flow throughout the west basin by dredging a new channel
5. Restore tidal flow to old wastewater treatment ponds
6. Removal of invasive plant species:

6-1 *Carpobrotus edulis*
6-2 *Carderia draba*
6-3 *Arundo donax*
6-4 *Cortaderia selloana*
6-5 *Acacia sp.*
6-6 *Eucalyptus sp.*

7. Management of riparian vegetation stands
8. ~~Re-colonize extirpated plant species~~
9. Contraction of cattail habitat from Central and Eastern Basins to east of dike

ENHANCEMENT

10. Dredging of mudflat to subtidal habitat in the central basin
11. Enlarge and increase network of lagoon channels in areas of low circulation
12. Maintain tidal ocean inlet
13. ~~Siting and construction of desiltation basins upstream~~
14. Management of freshwater runoff flows
15. Deepen and widen portions of the main channel
16. Straighten portions of the main channel
17. Manage input of point & non-point source pollution discharge to the lagoon
18. Dredge entire west basin to improve tidal flows and tidal prism
19. Enhance habitat of sensitive avian species:
    - Light-footed clapper rail
    - California leas tern
    - Belding's savanna sparrow
    - Snowy plover
    - Least Bell's vireo
    - California gnatcatcher
20. Lengthen existing railroad trestle
21. ~~Add culverts through railroad berm~~
22. Relocate ocean inlet and dredge new central channel
23. Manage input, deposition, and decay of marine algal wrack
24. Enhance dune habitat

PRESERVATION

25. Acquire sensitive lands around and upstream from the reserve.

Refer to Hard copy

for charts

Refer to Hard copy
for charts

4.1 CREATION PROJECTS

"The establishment of wetlands or other resources where one did not formerly exist".

Project 1. Excavation of upland terrain to create new wetland habitat and extension of tidal channels to these areas.

There are numerous upland areas adjacent to the lagoon that are candidates for excavating to lower elevations to enable tidal inundation and, thereby, creation of new saltmarsh habitat. The 10 sites that are proposed for this project are all located in the Central Basin. Characteristics of these sites are summarized in Table 4-1 and described below as Subprojects 1-1 through 1-10.

Purpose. The purpose of this project is to create new wetland habitat by excavation of upland terrain down to the elevation of adjacent existing wetland habitat. Each site is expected to become tidally flushed, but may also require excavation of new small connecting lagoon channels.

Objectives. The primary objective is to obtain a net gain in saltmarsh habitat for the lagoon. Secondary objectives will be to establish a true saltmarsh gradient from a low marsh to a high marsh community and to develop new Clapper Rail and Belding's Savanna Sparrow habitat (see Project 19). The constructed tidal channels will also encourage establishment of an intertidal benthic community that will support avian and fish species.

Approach. Each project area will be surveyed to characterize the species composition of the existing plant communities and to document presence of both sensitive and exotic species. An implementation plan will be developed for each proposed site. The existing sediment characteristics in each project area will be documented, but will be assumed to be appropriate for use in construction. Existing vegetation within the project boundary will be removed and disposed. Sediments will be removed using conventional earth moving equipment, and used onsite or trucked offsite. The project boundaries will be exposed to tidal inundation (see Project 12), and monitored for colonization by saltmarsh plant species. Some projects may require revegetation in order to stimulate colonization. Some project sites may also require slope protection. The following species abundance codes are used in the text below to qualitatively describe the dominant vegetation:

Plant Species Abundance Codes:

- **Frequent = ***
- **Moderate = ^**
- **Rare = +**

Monitoring and Remediation. Each creation project (i.e. Subprojects 1-1 through 1-10) will be monitored on a regular basis for soil characteristics, vegetation growth, and evidence

of erosion. Remedial measures may be needed to stabilize the upland bank slope and to control erosion. Additional planting may be needed to stimulate saltmarsh species growth. Since this project will create new habitat, no pre-construction biological site assessment is needed. Saltmarsh species assessment will be conducted to document successful percent coverage and species diversity after completion of the project. A control site will be chosen for baseline information and calculations. The sedimentary characteristics and status of the channel benthos will be assessed by successful recruitment of saltmarsh taxa. Each project site will be evaluated individually. Final evaluation of the project will be based on the successful colonization and development of a functioning saltmarsh.

Project 1-1. Alluvial Fan. This site consists of an alluvial sediment deposit that eroded into the wetland prior to 1939. This deposit is located on the South side of the lagoon. This site contains functioning Coastal Sage Scrub habitat, but it is of low quality at the lower elevations closest to the lagoon. Parts of the existing adjacent mudflats will need to be excavated to ensure tidal flow to the newly created elevations. The excavation will be split into three parts. Part 1 will consist of dredging one-third of the project area to a depth of at least) to 1.5 ft NGVD with a gradual incline into Part 2. Part 2 will consist of dredging the middle third of the area to a depth of 1.5 to 3.0 ft NGVD, and sloped to the upper third. Part 3 will consist of dredging the highest one-third of the area to an elevation of 3.0 to 4.5 ft NGVD and a gradual slope connecting the project with the existing Coastal Sage Scrub habitat. A sedimentation control device will need to be placed in the upland canyon to prevent further sedimentation of the project area from the canyon above. The upland area consists of near pristine Coastal Sage Scrub habitat down to about 50 ft from the edge of the saltmarsh. The following plant species are found within this first 50 ft zone.

Native Species	**Exotic Species**
Saltmarsh Plants:	
Juncus acutus +	*Brassica nigra* *
Distichlis spicata ^	*Foeniculum vulgare* *
Frankenia salina ^	*Ricinus communis* +
Salicornia virginica +	Annual Grasses
Jaumea carnosa ^	
Non-saltmarsh Plants:	
Lotus scoparius +	
Rhus integrifolia +	

Project 1-2. Trail Head. This site is located on the south side of the lagoon at the end of Rios Avenue, Solana Beach. This site has undergone extreme land slumping and erosion from street drainage which has caused sedimentation to occur in the wetland. The drainage problem was corrected by the City of Solana Beach. This site is dominated by exotic plant species, particularly *Arundo donax* the giant reed (see Project 6). The entire area will have to be eradicated of exotic species (see Project 6) prior to excavation. Due to the extreme slope above this area only low marsh will need to be created as a stable gradient at higher elevations would be difficult to develop. Native species only exist on the wetland bank.

Native Species	Exotic Species
Saltmarsh Plants:	
Typha sp. ^	*Ricinus communis* *
Scirpus robustus +	*Arundo donax* **
Salix sp. +	*Myoporum laetum*
Salicornia virginica ^	*Tropaeolum majus* ^
	Nicotiana sp. +

Project 1-3. South End. This site is located on the South side of the lagoon adjacent to the powerline access road that parallels the railroad. It is influenced by drainage of groundwater and by drying during summer (when the lagoon ocean inlet is closed). The existing saltmarsh is surrounded by exotic plant species. Some minimal construction impacts would occur to the saltmarsh.

Native Species	Exotic Species
Saltmarsh Plants:	
Salicornia virginica	*Myoporum laetum* **
Frankenia salina	*Carpobrotus edulis* *
Distichlis spicata	*Brassica nigra* ^
Typha sp.	*Oxalis sp.* ^

Project 1-4. Southeast End. This site is located in the southeast end of the lagoon adjacent to the I-5 Freeway. It is influenced by drainage from groundwater. Due to the long shoreline length of this site, four segments were examined. Transects 1 and 2 are represented by sparse presence of native species and are dominated by invasive exotic species. Some impacts to saltmarsh species may occur during construction at lower elevations, but with proper planning this can be avoided. Transect 3 consists of exotic species with one small stand (50 ft by 50 ft) of coastal sage brush of medium value. The area continues to lose value due to the expansion of exotic species. Transect 4 is a highly disturbed area due to several factors, but primarily due to presence of an upland drainage system from the City of Solana Beach which is causing considerable erosion. Exotic species have taken over this area and are out competing any natural habitat that remains.

Native Species	Exotic Species
Transect 1 & 2.	
Hazardia squarrosa ^	*Raphanus sativus* *
Baccharis sp. +	*Eucalyptus sp.* *
Lotus scoparius +	*Carderia draba* *
Artemsia californica +	*Foeniculum vulgare* *
Saltmarsh Plants:	*Brassica nigra* *
Distichlis spicata ^ low	*Acacia sp.* *
Frankenia salina ^ low	*Heterotheca sp.* ^
Salicornia virginica ^ low	Annual grasses **

Rumex crispus +
Typha sp.

Transect 3.

Salvia mellifera ^ — See text description
Eriogonum fasciculatum ^

Transect 4.

Salix sp. ^
Carpobrotus edulis *
Cortaderia sellocana *
Eucalyptus sp. *
Acacia sp. *

Project 1-5. Manchester Avenue Trail. This site is located on the North edge of the lagoon and is immediately adjacent to Manchester Avenue. It is a disturbed upland area that contains a short walking trail. The site contains mixed coastal sage brush mixed with many exotic plant species. Wetland species are constrained to the lagoon shoreline.

Native Species	Exotic Species
Eriogonum fasciculatum +	*Carpobrotus edulis* *
Lotus scoparius +	*Acacia sp.* ^
Artemsia californica +	*Myoporum laetum* *
Juncus acutus +	*Raphanus sativus* *
Hazardia squarrosa ^	*Foeniculum vulgare* ^
Scirpus robustus ^	*Cotula sp.* ^
Typha sp. ^	*Heterotheca sp.* ^
	Annual grasses

Project 1-6. Manchester Avenue Storm Drain. This site is located on the north edge of the lagoon, adjacent to the intersection of Manchester Avenue and Ocean Cove Drive, and is next to Project 1-5. This site contains disturbed riparian habitat that is sustained by a stormwater drain that flows under Manchester Avenue. Stormwater flow to the lagoon is constrained by overgrowth of plants. The riparian area has been disturbed by growth of exotic species.

Native Species	Exotic Species
Salix sp. ^	*Acacia sp.* ^
Typha sp. ^	*Cortaderia selloana* ^
Scirpus robustus ^	Annual grasses

Project 1-7. Old Railroad Berm. This site is located on the North edge of the lagoon adjacent to the existing railroad, and contains an old railroad berm spur. It is also adjacent to an extreme slope. The area is dominated by exotic species. Some wetland species will be

impacted during excavation of a small channel to help flood the area at the base of the berm (10 ft by 10 ft).

Native Species	Exotic Species
Salicornia virginica ^	*Myoporum laetum* *
	Carpobrotus edulis *
	Annual grasses

Project 1-8. Sewage Outfall Pipe Berm. This site is located on the West side of the Central Basin adjacent to the powerline access road. It is an old construction site that was created when a trench was excavated across the bed of the lagoon to install a wastewater ocean outfall pipe and the trenched sediments were side caste. Approximately 50% of the berm area will be reduced in elevation and converted to saltmarsh. The ocean pipe will not be disturbed. Wetland species and exotic species can be found on the berms.

Native Species	Exotic Species
Saltmarsh Plants:	
Salicornia virginica +	*Myoporum laetum* *
Frankenia salina +	Annual grasses **
Distichlis spicata ^	

Project 1-9. powerline Access Road. This site contains an elevated gravel access road and several short road spurs that enable trucks to turn around. The gravel road will be removed and converted to saltmarsh. Alternatively, the gravel road could remain in place, but excavated at various points to install culverts that would facilitate tidal flows under the powerline access road to poorly circulated channel mudflat located between the powerline access road and the railroad. This area was divided into three sections from South to North as follows:

Section 1. Channel between railroad and service road from the most southerly point to the Solana Beach sewer pump station. This area has saltmarsh vegetation, but many exotic plant species have become established due to lack of tidal flow.

Native Species	Exotic Species
Saltmarsh Plants:	
Salicornia virginica	*Myoporum laetum* *
Frankenia salina *	*Carpobrotus edulis* *
Distichlis spicata *	*Brassica nigra* ^
Typha sp.+	*Oxalis sp.* *
Jaumea carnosa ^	*Trifolium sp.* *
Juncus acutus +	*Foeniculum vulgare*
Non-Saltmarsh Plants:	*Arundo donax* **
Rhus integrifolia +	*Nicotiana sp.* +
Hazardia squarrosa ^	*Acacia sp.*
Lotus scoparius +	*Raphanus sativus* ^

Section 2. Pump station to old sewage settling ponds. This area has existing saltmarsh on both sides with very few exotic plant species. Exotic species occur on the service road and on the shoulder of the road.

Native Species	**Exotic Species**
Saltmarash Plants:	
Salicornia virginica *	*Oxalis sp.* ^
Frankenia salina *	*Trifolium sp.* ^
Distichlis spicata *	*Cotula sp.* ^
Typha sp. +	
Jaumea carnosa ^	
Juncus acutus ^	

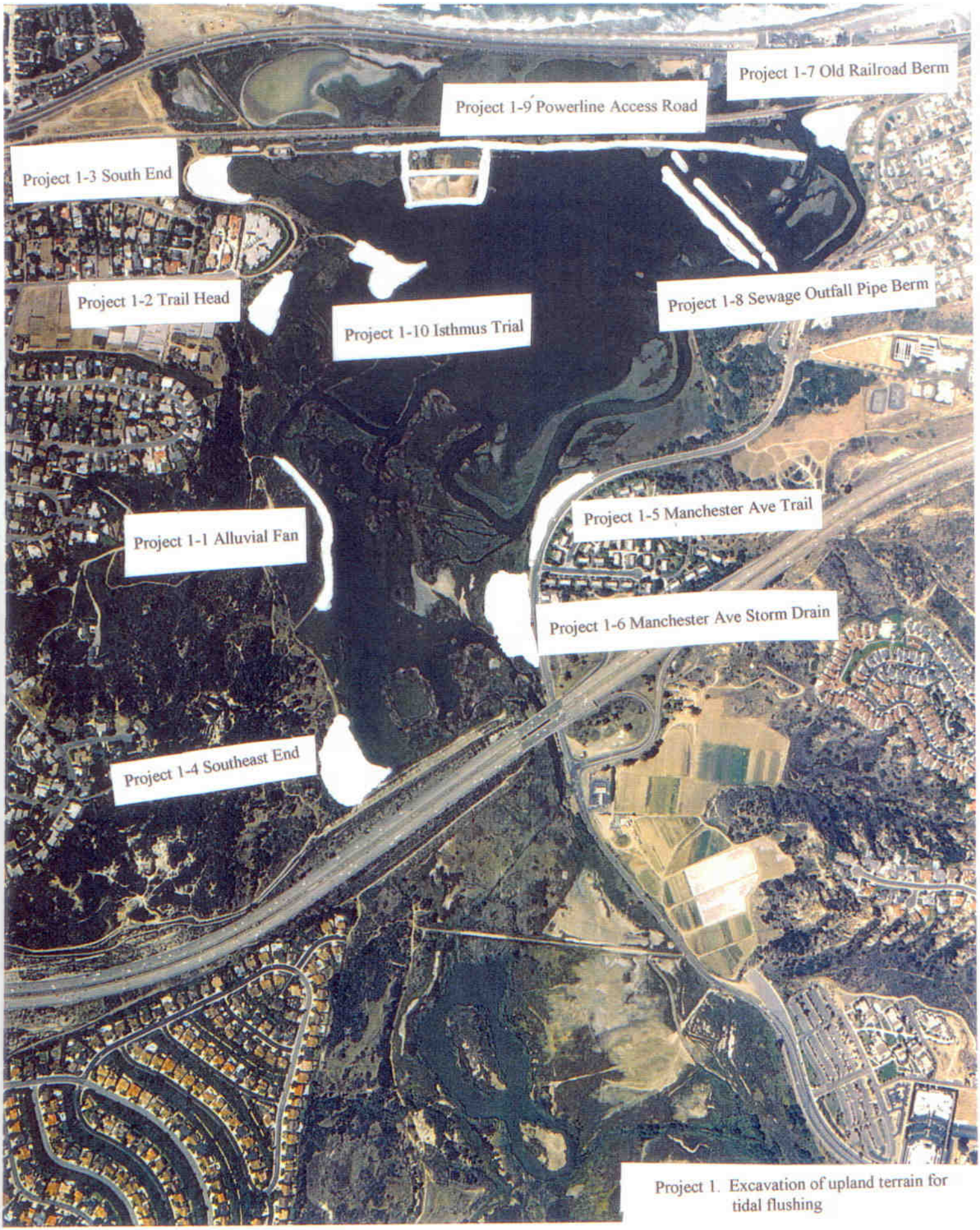
Section 3. Beginning of the gravel road North to the end of the road. The road dead ends into the main channel of the lagoon near the railroad trestle. Saltmarsh occurs on both sides of the road. The few exotic species that occur are found only on the road.

Native Species	**Exotic Species**
Saltmarsh Plants:	
Salicornia virginica *	*Trifolium sp.* ^
Frankenia salina *	*Cotula sp.* ^
Distichlis spicata *	Annual grasses
Jaumea carnosa ^	
Juncus acutus *	

Project 1-10. Isthmus Trail. This site contains a trail that extends out into the lagoon and leads to an old duck pond. Existing saltmarsh transitions from the mudflat and channel upwards to increasing presence of exotic plant species near the trail path.

Native Species	**Exotic Species**
Saltmarsh Plants:	
Typha sp. ^	*Myoporum laetum* ^
Scirpus robustus +	*Trifolium sp.* *
Salicornia virginica ^	
Salicornia subterminalis +	
Distichlis spicata *	
Frankenia salina *	
Juncus acutus +	

Exhibit 4: San Elijo Lagoon Action Plan



Project 1. Excavation of upland terrain for tidal flushing

Project 2. Introduce eelgrass habitat.

Eelgrass (*Zostera marina*) is a valuable primary producer and provides habitat for juvenile fish and forage for Coots and Brants. Eelgrass requires a sandy substrate and relatively clear water. However, eelgrass does not currently occur in San Elijo Lagoon. The nearest areas that support persistent beds of eelgrass are Agua Hedionda Lagoon and Mission Bay. If the West Basin is dredged to provide subtidal habitat for fish (see Project 18) then water quality and sediment substrate conditions may be adequate to support development of eelgrass habitat in the North end of the West Basin, between the railroad trestle and the ocean outfall pipeline.

Purpose. Establish a viable bed of eelgrass in San Elijo Lagoon.

Objectives. Develop appropriate subtidal habitat (i.e. sediment characteristics and water quality conditions) by dredging the West Basin. Initiate development of an eelgrass bed by transplanting plugs of eelgrass taken from an approved donor site.

Approach. Maintenance of tidal flushing in the lagoon (see Project 12) and dredging of the West Basin (see Project 18) will provide subtidal habitat for fish, and may provide adequate substrate and water quality conditions for settlement and growth of eelgrass. Monitor maturation of sediment conditions that will support eelgrass. Eelgrass plugs will be transplanted from a local donor site and fertilized using methods developed by the NMFS. The experimental area should be a minimum of 1 acre, but if the transplant project is successful, a total of 3-4 acres may be possible.

Monitoring and Remediation. Monitor growth and reproduction of the transplanted plugs, and of any seeded individuals.

Project 2. Introduce Eelgrass Habitat

Project 3 Introduce Cordgrass Habitat

In San Diego County there are only three estuarine systems that contain the plant *Spartina foliosa* or cordgrass. Though this plant species is not listed as endangered or even rare, it does fall under a protected habitat because of the Light-footed clapper rail. When the clapper rail was listed as a federal and state endangered species its habitat (the low salt marsh species *Spartina foliosa*) became protected as well. In San Elijo Lagoon there are clapper rails that utilize the system, but there is no cordgrass. Instead, the rails have adapted to using the tall freshwater plant such as *Typha sp.* and *Scirpus sp.* to nest in. These plants can withstand long inundation periods of fresh and brackish water, but they will be negatively affected by a full tidal system. It is our goal not to have a net loss of clapper rails in the system but rather increase in their numbers.

Purpose. This project is part of several other projects listed in the Action Plan. The purpose of this project is to plant cordgrass in those areas that are suitable for its growth and that were either part of Project 1, Project 9, or Project 19-1. The overall goal is to increase the natural habitat for the Light-footed clapper rail and to introduce a low saltmarsh species into the lagoon (there are no low saltmarsh species in SEL at this time).

Objective. Objective is to increase the natural nesting habitat for the Light-footed clapper rail and to create a low marsh boundary within the tidal area of the lagoon. With these objectives in mind the lagoon will provide a more sufficient nesting and foraging habitat than the areas outlined by Projects 1 and 9.

Approach. Under Project 1 the approach will be to allow for grading on the created areas to include the maximum area for cordgrass. This will be accomplished by using existing data and literature on height, slope, and tidal inundation that this plant requires. All areas will be planted for maximum area coverage and areas will be sloped gently so that a defined transition zone between low marsh and mid (*Salicornia virginica*) marsh is present.

Under Project 9 the approach will be a little different than that of Project 1. Because the rails are still using *Typha sp. & Scirpus sp.* to nest in, it is advisable that this portion be phased in sections. There are many different scenarios by which this could be completed. Since extraction of the cattails in the East Basin will only be successful if Project 14 (manage stormwater runoff) and Project 16 (straighten a portion of the main channel to allow tidal action into the East Basin) are implemented -- It would be advisable if cordgrass planting began at the deepened channels (in East Basin) outward. This way the cordgrass would be given a chance to establish and rails could still use the existing cattails to nest until the correct canopy was obtained. After this area had become successful then other sections could be started. Project 19-1 will be discussed in that section.

Monitoring and Remediation. Monitoring for success of revegetation will consist of achieving a successful canopy height and density of stems per meter squared. Monitoring protocols will follow proven methods that have been established by Pacific Estuarine

Research Lab at San Diego State University. It will be important to monitor newly created areas for erosion and panning. Any area that shows lack of proper inundation will have to be regarded and planted.

Refer to Hard copy for charts

4.2 RESTORATION PROJECTS

> ***"Re-establishment of previously existing wetland or other aquatic resource character and function(s) at a site where they have ceased to exist, or exist only in a substantially degraded site".***

Project 4. Restore tidal flow throughout the West Basin by dredging a new channel.

Tidal flushing of the West Basin is very poor. Circulation is constrained by shallow, narrow channels in the area located behind the Highway 101 restaurants and south of the railroad trestle, an East-West berm created by installation of the San Elijo sewage outfall pipe, and another East-West berm with installation of a small sewage pipe from Solana Beach to a new sewage pump station located at the South end of the West Basin. Tidal exchange occurs primarily during spring tides. This project could be expanded to include dredging the existing mudflats throughout the entire West Basin (see Project 18).

Purpose. The purpose of this project is to improve tidal flows throughout the West Basin, including the closed area at the South end of the basin, but to retain the present elevation of the existing mudflat.

Objectives. Increase circulation and flushing throughout the entire West Basin. Open the southern closed, stagnant end of the basin to tidal flushing. Encourage long term recovery of the presently degraded intertidal benthic mudflat community and increase fish habitat.

Approach. Dredge a 100 ft wide channel to a depth of -4 ft NGVD, i.e. 6 ft below the existing grade, and primarily down the middle of the basin. Dispose of the top 1-2 ft of fine sediments by de-watering onsite and trucking offsite. Use the bottom 5-6 ft of dredged sand for beach replenishment at Cardiff State Beach. Slurry pump sediments for beach replenishment via a new pipe installed under Highway 101. The final dredging plan will have to include engineering considerations for use of appropriate intertidal slopes adjacent to the railroad berm and saltmarsh habitat, and for the long term protection of the ocean outfall pipeline and Solana Beach sewer pipeline. Twenty percent of the sediment is assumed to be comprised of fine material and 80% is assumed to be coarser sediment and appropriate for use in beach replenishment.

Monitoring and Remediation. The topography of the West Basin will be surveyed before and after the project to document completion of the dredging project as designed. Tidal currents in the vicinity of the flow restriction sites will be measured in order to assure protection of existing pipelines and restaurant property. Rock rip rap may have to be installed at the flow restriction points to eliminate any bank erosion. The sedimentary characteristics and status of the benthos in the West Basin sediments and the condition of the adjacent marsh habitat will be evaluated before and after the project. This assessment will also include consideration of impacts of disposal of sand on Cardiff State Beach and the nearshore subtidal community.

Project 4. Restore tidal flow throughout the west basin by dredging a new Channel

Project 5. Restore tidal flow to old wastewater treatment ponds.

This site is located on the West side of the Central Basin adjacent to the powerline access road. It contains two old sewage ponds and several cement tanks. This site was once operated as a sewage settling pond for the City of Solana Beach and has not been utilized for this purpose since 1966. The ponds have been blocked from tidal flow by artificial berms that were created to settle sewage sludge.

Purpose. Reestablish tidal circulation, wetland habitat, and benthic communities to this area in order to restore its former wetland value.

Objectives. Lower the existing pond berms to enable tidal flow. Reestablish low saltmarsh vegetation within the project area boundary. Performance standards will show successful long term recovery of intertidal wetland plant species such as *Salicornia virginica.*

Approach. Since the historical use of this site was for treatment of municipal wastewater the pond sediments will have to be sampled for potential toxicity before excavation. The pond berms will be removed down to 1 to 2 ft NGVD. This will require 3,890 yd3 of soil to be removed from an area of about 5 acres. Sediments will be removed by truck. Some surface sediments will be removed from the bed of the settling ponds (i.e. 500 to 1,000 yd3). The berms are assumed to be made of fill dirt which may not be suitable for beach replenishment, especially considering the past use of the project site. The ponds accumulate precipitation and infiltration during the winter and dry out during the summer. The bed of the ponds is assumed to contain a layer of sewage sludge. The bed of the East pond is mostly non-vegetated, while the bed of the West pond contains saltmarsh. The following designs could be implemented at this site: 1) Remove all berms and convert to intertidal saltmarsh habitat, 2) remove all berms and the bed of the East pond, or 3) convert to Least tern habitat. It may also be possible to grade the berm sediment over the bed of one of the ponds . This site could also be used on an interim basis to dewater dredged sediments from the lagoon and then convert it to a final use design. The berms are dominated by exotic plant species but some saltmarsh plant species have colonized the outside of the berms.

Native Species	**Exotic Species**
Saltmarsh Plants:	
Salicornia virginica +	*Myoporum laetum* **
Frankenia salina +	*Carpobrotus edulis* **
Distichlis spicata ^	
Pond Interior Species:	
Salicornia virginica *	
Jaumea carnosa ^	
Frankenia salina ^	
Cressa truxillensis ^	

Monitoring and Remediation. The topography of the settling ponds will be surveyed before and after the project to document completion of the dredging project as designed. At the completion of the dredging part of the project, saltmarsh plant species will be planted on site and follow the same evaluation standards as described in Project 1. The site will need a chemical and toxicological assessment before any dredging can occur within the site. Tidal currents will need to be measured before and after the project to anticipate what erosion patterns may also occur at the site. Assessment of surrounding plant communities will also be done (Note: Two long term study vegetation transects occur in the area and will be used as a baseline to assess changes due to the project). Successful performance of the created saltmarsh will be evaluated by measurement of species diversity, density, and intertidal exchange.

Project 5. Restore tidal flow to old wastewater treatment ponds

Project 6. Removal of exotic plant species.

San Elijo Lagoon has been invaded by exotic plant species ever since tidal flow became restricted due to construction of three transportation corridors, i.e. Highway 101, the Santa Fe Railroad, and the I-5 Freeway. Private and commercial landscaping have also played a major role in introducing many exotic plant species. Although there are many exotic plant species within the lagoon and their impacts are noticeable throughout the lagoon, the following plant species are causing particularly serious problems to saltmarsh habitats: Iceplant (*Carpobrotus edulus*), Giant reed (*Arundo donax*), Hoary Cress (*Carderia draba*), Pampas Grass (*Cortaderia selloana)*, Acacia (*Acacia sp.*), and Blue Gum (*Eucalyptus sp.*).

Purpose. The primary purpose of this project is to eradicate the invasive plant species from within the saltmarsh habitat and promote re-establishment of saltmarsh species.

Objectives. Although, the overall common objective is to remove these exotic plant species, the methods for implementation will differ for each species. Since some of the species selected have impacted saltmarsh habitat, reintroduction of tidal flushing will promote recolonization by saltmarsh plant species, and deter recolonization by the exotic plant species.

Approach. The project will focus on control of six exotic plant species. General approaches for removing exotic plant species, include the following: Manual, mechanical, biological, chemical, and fire control. Although, the exotic plant species have a patchy distribution the sites listed below are particularly serious problem areas. The following are the affected areas and the exotic plant species that are aggressively occupying habitat:

Exotic Plant Species	Lagoon Area in Figure 4-1
1. Iceplant	6-1
2. Giant reed	6-2
3. Carderia	6-3
4. Pampas grass	6-4
5. Acacia	6-5
6. Eucalyptus	6-6

Iceplant occupies a total of about 3 acres throughout the lagoon. The affected areas all have easy access and manual control is proposed. When iceplant is removed there is often a viable saltmarsh seed bank underneath so natural recruitment may be the best method of revegetating the site. Giant reed occupies about 3 acres and is extremely difficult to eradicate so both mechanical and biological methods will be used (see Project 1-2). The biological control will be salt water inundation after dredging/grading. Since *Carderia* is easily pulled from the ground (especially when the inflorescent is showing), manual removal is used. It is estimated that *Carderia* occupies about 1 acre. Some of this area may overlap with Project 1-1.

Monitoring and Remediation. Each site will have permanent transects in place which will be monitored on a yearly basis for evidence of further encroachment of exotic species and to monitor the success of the revegetation. Remedial work will need to be addressed quickly as re-establishment may occur due to seed banks and fragments of exotic plant species left in the soil. Vegetation surveys will be conducted at each site before and after removal of the exotic plant species. A series of assessments will be conducted over the duration of the project to insure a successful project. The immediate surrounding area will also be assessed for presence of exotic plant species which may take advantage of the new open space. Changes in the surrounding areas will be addressed by increasing the vegetation monitoring program throughout the lagoon which could include ADAR imagery. Performance will be evaluated by the successful eradication of the exotic plant species and successful colonization and growth of saltmarsh species.

Refer to Hard copy for charts

Project 7. Management of riparian vegetation stands.

The San Elijo Ecological Reserve has several areas that are covered with riparian vegetation. The continued urban runoff, development, and the introduction of exotic plant species has caused this habitat to undergo a loss of native diversity. This project is outlined and attached to several other projects listed in the Action Plan. These projects are: 6 {removal of exotic species, 6-1 (Iceplant), 6-3 (Giant reed), 6-4 (Pampas grass), 6-5 (Acacia), 6-6 (Eucalyptus)}, 14, 17, 19-5, & 25.

Purpose. To improve and expand existing riparian stands throughout the reserve.

Objectives. This project is intended to reestablish habitat that has been overrun by exotic species inorder to promote the long-term survival of the sensitive Least Bell's Vireo. This project is also intended to increase the riparian habitat along the corridors of the Escondido and La Orilla Creeks by means of acquisition. This will add a significant buffer to the existing watershed for continuous protection from non-point source pollution inputs.

Approach. This will be accomplished by identifying target exotic species in riparian stands and using best management practices to eliminate them. Access may be limited in areas so different methods may need to be used to accomplish the same goal. Any revegetation should be conducted during the spring when ground water is best for establishment and the threat of flooding is less. Only native species found in the reserve should be used.

Monitoring and Remediation. The monitoring will be intensive for tough invasive species (see Arundo, Iceplant, and Pampas grass removal 6-3, 6-1, 6-4). Continual removal may be necessary for a period of time to ensure complete eradication. Revegetated sites will need to be monitored for success. Irrigation and fertilization may need to be implemented in those areas that show little growth.

Project 7. Management of riparian vegetatio
stands

~~Project 8. Recolonize extirpated species.~~
Not included in this report.

Project 9. Contraction of cattail habitat from Central and Eastern Basins to East of dike.

Cattails (*Typha sp.*) and Bull Rush (*Scirpus robustus*) have invaded the Central and Eastern Basins since the I-5 Freeway was constructed across the lagoon around 1965-1966. Since the mouth of San Elijo Lagoon has been primarily closed during the past 30 years, Fresh/Brackish water marsh plant species have invaded areas that were once only saltmarsh. The accumulation of these invasive species West of the I-5 Freeway has severely choked off tidal flow to the East Basin. Another result has been the reduced fluvial flow rates and increased sedimentation that has resulted from the accumulation of cattails in the channels. This has affected flushing of suspended fluvial sediments to the ocean. Instead, the sediments are deposited in the channels and over the bed of the marsh, which further reduces fluvial flows and affects water quality conditions. This project will be divided into two sub-projects, because the methods used to conduct the project may differ for each location. **Project 9-1** will focus on removal of cattails from the East Basin. **Project 9-2** will remove cattails from the Central Basin.

Purpose. To remove Fresh/Brackish water marsh plant species so that tidal flow of sea water will extend into the East Basin up to the dike and increase flood water dissipation through key parts of the Central Basin. The East Basin will need to be planted with saltmarsh species after extraction is completed. This project is linked to Projects 11-3, 12, and 16. Without completion of these other projects, this project will not be successful.

Objectives. Regain lost wetland habitat due to construction of the I-5 Freeway and long periods of standing freshwater in the saltmarsh area. Field procedures will be in place to avoid disturbance of endangered bird species during nesting seasons.

Approach. The County of San Diego Department of Vector Control has previously used fire as a method for controlling the cattails in the East Basin. This would be the best method to use and should be done in conjunction with the linked projects mentioned above. After the area has been burned, new tidal channels will be excavated through the cattails. A 100 ft wide channel will be excavated from the I-5 Freeway eastward along the path of the existing channel for a distance of about 500 ft. This channel will then be split in half, and two 50 ft wide channels will be excavated to connect directly to the two gate valves that control water flows through the dike in the East Basin. The channels will be excavated to a depth of -4 ft NGVD. Circulation of salt water to the area is expected to slowly kill off the remaining root systems. This project should be conducted during the late summer in order to avoid flood periods and to increase drying of the plants. Coordination with the local fire department will be necessary. The cattail and bull rush areas in the Central Basin would need to be completely dredged out (root system included) to achieve the desired results. The best method would be to cut the vegetation and mechanically dredge the areas.

Monitoring and Remediation. Changes in the water level and salinity in the East Basin will be monitored to insure that sufficient tidal flow and intrusion of salt water is occurring.

Circulation of salt water to the East Basin will aid in discouraging any further recruitment of the brackish plant species that currently reside there. If plant regeneration occurs then additional subchannels may need to be excavated to increase salt water circulation to the area. The Central Basin will be monitored for regeneration of saltmarsh plant species. The species to be removed are jurisdictional wetland species that have invaded an area that was historically saltmarsh. Accordingly, an assessment of the value of this habitat will have to be conducted before work could begin. Current law states that as long as they are not physically dug out of the ground you can trim, mow, or burn the species. This would have to be taken into consideration when assessing this project. The projects evaluation and performance will be based on successfully introducing tidal flow to the East Basin and increasing storm runoff flow rates through the Central Basin. Monitoring should be conducted before and after the project to demonstrate the increase in salinity and flow rate through the East and Central Basins.

4.3 ENHANCEMENT PROJECTS

> ***"Activities conducted in existing wetlands or other aquatic resources to achieve specific management objectives of conditions which previously did not exist, and which increase one or more aquatic functions. Enhancement may involve trade-offs between aquatic resource structure, function, and values; a positive change in one function may result in negative effects to other functions".***

Project 10. Dredging of mudflat habitat to subtidal habitat in the Central Basin.

"Non-tidal" mudflat is one of the dominant habitats within San Elijo Lagoon. Due to extremes of conditions, e.g. seasonally accumulated stormwater runoff and summer drying, and poor, intermittent tidal flushing, the mudflat habitat has become degraded. Poor circulation and accumulated organics have created anaerobic sediment conditions. Subtidal habitat, presently limited to the channel beds, is a minor habitat within the lagoon and could be expanded substantially. Increased acreage of subtidal habitat would facilitate overall enhancement of the lagoon by increasing tidal flushing and by increasing fish habitat.

Purpose. Increase marine circulation within the lagoon and increase subtidal open water habitat by dredging selected areas of the existing mudflat.

Objectives. Increase subtidal fish habitat in the lagoon.

Approach. Identify areas of low circulation that exhibit a degraded benthic community. Document the sediment characteristics in these areas at the surface and down to the dredging depth. Slurry dredge the selected area(s) and dewater the fine sediments within the lagoon for subsequent removal off site by trucking. Sediment suitable for beach nourishment may be pumped to Cardiff Beach. The size of this project will be constrained by ability to dispose or utilize the dredged sediments. Two subprojects are proposed. **Project 10-1** is located in the vicinity of the West end of the ocean outfall pipeline adjacent to the powerline access road. Two deep water areas would be dredged, one North and one South of the outfall pipeline berms. A 75 ft wide connecting channel will be excavated South along the edge of the powerline access road to the vicinity of the old sewage treatment ponds, and then connect to a new channel associated with Project 11-1. **Project 10-2** is located in the middle of the Central Basin and will create a new channel, with two enlarged areas, that will connect to an existing channel in the center of the basin next to a large old duck pond. The new channel will be 50 ft wide and the two enlarged areas will be about 400 ft wide. The channel portions of this project will be dredged to a depth of -3 ft NGVD. The enlarged areas will be dredged to a depth of -3 ft NGVD.

Monitoring and Remediation. The topography in the vicinity of the new channels and expanded subtidal areas will be surveyed before and after the project to document completion of the dredging project as designed. Control measures will be used to minimize

runoff effects of dewatering the sediment slurry. The status of the benthic community at the candidate dredge sites will be evaluated before and after the project, and development of fish habitat will be monitored.

Project 10. Dredging of mudflat to subtidal habitat in the Central Basin

Project 11. Extend lagoon channels in the Central Basin into three areas of low circulation.

Some of the existing mudflat habitat in the Central Basin only receives circulation during high spring tides or during periods of heavy fluvial stormwater runoff, and may dry out during periods of no flow. The following areas in the lagoon exhibit this very reduced tidal circulation: **Project 11-1** the long narrow area between the railroad berm and the powerline access road; **Project 11-2** the South end of the West side of the Central Basin next to the wastewater pump station; and **Project 11-3** the Southeast corner of the Central Basin next to the I-5 Freeway.

Purpose. The purpose of this project is to extend tidal flows to three lagoon areas of very reduced tidal circulation.

Objectives. Enhance the mudflat habitat in areas of the Central Basin that exhibit low tidal circulation and seasonal drying.

Approach. Slurry dredge a new 15 - 125 ft wide channel along the powerline access road to Area 1 (**Project 11-1**), a 50 ft wide channel (with expanded areas to 250 ft wide) to Area 2 (**Project 11-2**), and a 50 ft wide channel from the center of the basin to the Southeast corner next to the I-5 Freeway as Area 3 (**Project 11-3**). Dewater the dredged sediments onsite within the lagoon and dispose by trucking off site. The project will require dredging about 17,000 yd3 from Area 1, 48,000 yd3 from Area 2, and about 22,000 yd3 from Area 3. The new mudflat channels will be dredged to a depth of -4 ft NGVD. The expanded areas of these channels will be dredged to a depth of -3 ft NGVD.

Monitoring and Remediation. The new channels will be surveyed after construction to verify conformance to construction specifications. Changes in water level, currents, salinity, and water quality will be monitored to document improved circulation performance. The sedimentary characteristics and status of the benthos in the new channels and adjacent mudflats, and any adjacent saltmarsh habitat will be evaluated before and after the project.

Project 11. Enlarge and increase network of lagoon channels in areas of low circulation

Project 12. Sustain tidal flushing by maintaining an open tidal inlet.

This project will have a major long term affect on enhancing the entire lagoon ecosystem. Most of the existing lagoon bed will experience intermittent tidal submergence during spring tides. Significant beneficial changes in both the structure and function of the lagoon biological community can be expected. The salinity regime in San Elijo Lagoon has historically remained below 15 o/oo. Sustained tidal flushing would improve the salinity regime to that similar to Los Penasquitos Lagoon, i.e. 20 - 25 o/oo.

Purpose. The purpose of this project is to implement an ocean inlet maintenance strategy and to monitor the results so that the inlet maintenance plan can be fine tuned.

Objectives. Implement the inlet and main channel maintenance plan on an intermittent, as needed basis.

Approach. On-going long term lagoon monitoring (e.g. water quality data) and conditions of the lagoon ocean inlet and main channel (e.g. topographic survey data) will signal the requirement to increase the lagoon tidal flushing by increasing the tidal prism. Acquire permit from the California Coastal Commission. Mobilize maintenance equipment and excavate sediments according to the locations, areas, and depths specified in the plan and dispose of the sediments. The ocean inlet and main channel will be dredged to a depth of -4 ft NGVD and to a width of 75 ft - 150 ft.

Monitoring and Remediation. The short term effectiveness of the maintenance dredging effort will be verified by conducting a post-maintenance topographic survey. The long term effects will be documented by the on-going long term lagoon monitoring project.

Project 12. Maintain tidal ocean inlet

~~**Project 13. Siting, design and construction of sedimentation basins upstream.**~~
Not included in this plan

Project 14. Management of freshwater runoff flows through the lagoon.

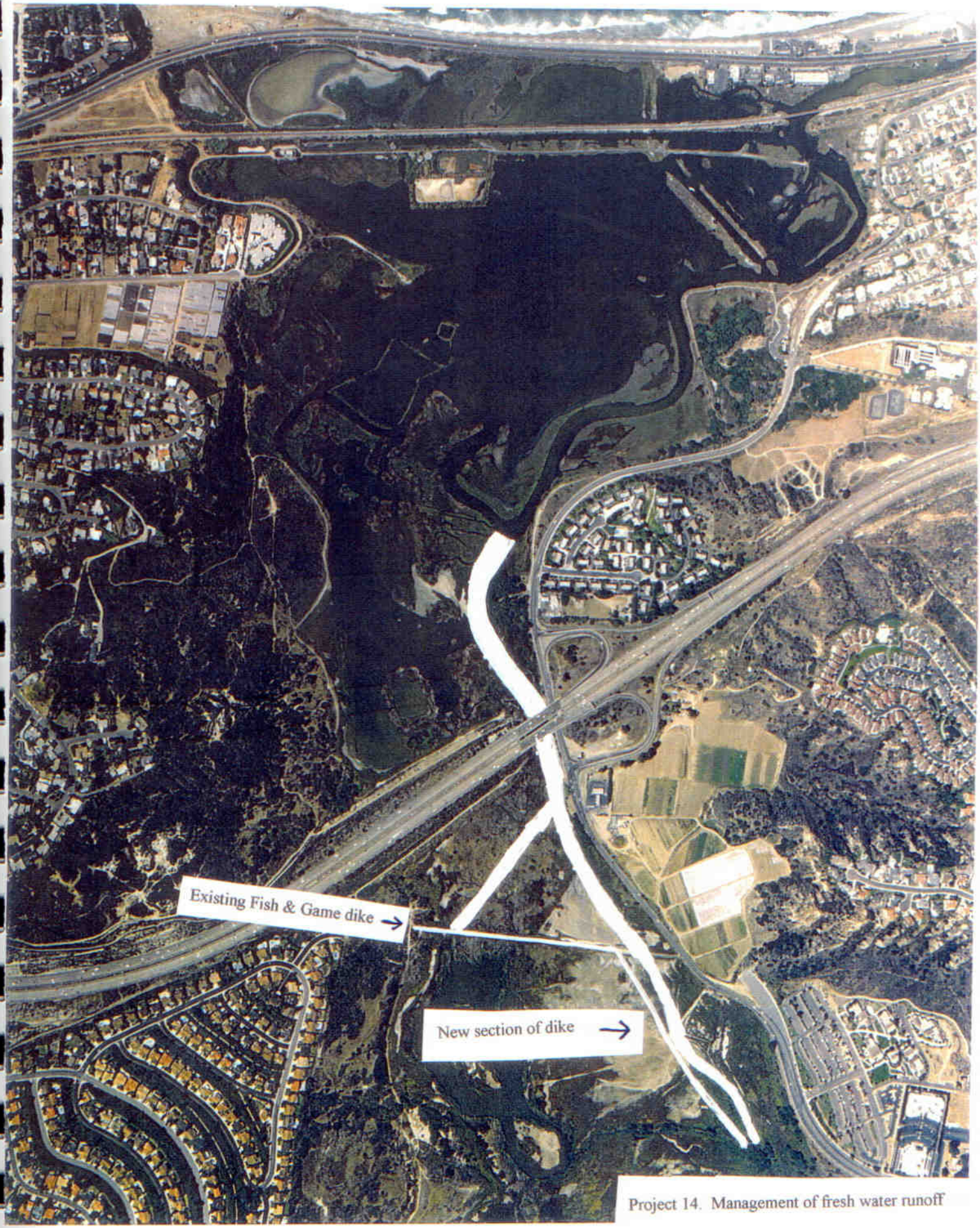
Fluvial runoff is currently "managed" by presence of a flood control dike across the entire East Basin, and two gate valves through the dike. West of the dike flow to the ocean is constrained by over growth of cattails, narrow channel widths and shallow channel beds, three flow choke points (i.e. I-5 Freeway, railroad trestle, and Highway 101 bridge), and the circuitous path of the main channel. During infrequent flood flows the elevations of the channel sides are exceeded and the flow velocity is dispersed over the entire surface of the lagoon. The dike was designed to create freshwater duck habitat East of the dike by retaining fluvial input, and to slowly drain off excess flood water via the gate valves. The freshwater is also retained in a pond located East of the dike.

Purpose. The purpose of this project is to manage the flow of fluvial stormwater runoff through the lagoon more effectively in order to facilitate flushing of accumulated organics and fine sediments from the lagoon and marine sediments from the ocean inlet.

Objectives. Manage fluvial flows by focusing runoff more directly through the lagoon. Flush accumulated organics and fine sediments from the channel bed. Facilitate scouring of accumulated marine sediments from the ocean inlet. Maintain existing freshwater duck pond habitat East of the dike.

Approach. Redesign the present configuration of the East Basin dike so that the North end of the dike at Manchester Avenue is removed and replaced by a new dike oriented in a Northeast direction for a distance of approximately 1400 ft. Excavate and broaden the existing channel between the I-5 Freeway bridge and the dike to 100 ft wide. Excavate and broaden the existing channel East of the dike and Northeast to the fork in the existing channel of Escondido Creek. The result will direct major flows along the channel adjacent to Manchester Avenue. Replace the existing gate valves with a new method of flow control and construct a new large flow culvert where the North end of the dike was removed. Dredge a new 100 ft wide channel in the Central Basin in the vicinity of Ocean Cove Drive to linearize flow through the lagoon (see Project 16). Coordinate fluvial management program with the ocean inlet maintenance plan.

Monitoring and Remediation. Monitor pre- and post-project fluvial flow rates before and after a major runoff event. Monitor changes in water level and water quality conditions in the freshwater pond. Measure changes in sediment characteristics and benthos in the channel bed and conditions in the adjacent saltmarsh before and after the proposed project and after the major fluvial runoff event. Monitor water quality conditions in the existing freshwater pond habitat and changes in the areal distribution of cattail habitat.



Project 14. Management of fresh water runoff

Project 15. Deepen the bed of the existing lagoon channels by 3 ft.

Most of the lagoon channels East of the railroad bridge have accumulated a deposit of fine, anaerobic organic sediment. Ebb tidal flow velocities are inadequate to remove these deposits. Presumably some organic materials are resuspended and scoured during times of heavy fluvial stormwater runoff. Initial flood tides are constrained to the narrow and shallow channels, such that a lag time in change in water levels at the I-5 Freeway bridge of about 0.5 hours.

Purpose. The purpose of this project is to enhance the ecological conditions throughout the lagoon by increasing tidal circulation, and to restore the conditions in the channel beds by removing the accumulated burden of fine sediments.

Objectives. Dredge the surficial burden of accumulated fine, organic sediments from the bed of the existing lagoon channels.

Approach. Use a slurry pumping system to dredge all channels, ranging in size from 25 ft to 100 ft in width to a depth of -4 ft NGVD. The proposed dredging volumes and associated acreage are summarized in Table 4-1. The fine sediments will be dewatered at a local lagoon site (e.g. old wastewater treatment ponds or in part of the West Basin) and then trucked off site.

Monitoring and Remediation. Pre- and post-project channel characteristics will be surveyed to document the results of the dredging effort. The effectiveness of the project will be evaluated by comparing pre- and post-project tidal current velocities in selected channels and any changes in the tidal prism. Water quality data obtained from the long term monitoring program will be used to evaluate changes in the salinity regime due to increased tidal circulation and to stormwater runoff events. The sedimentary characteristics and status of the benthos in the channel sediments and the water quality conditions in the channels will be evaluated before and after the project.

Project 16. Straighten portions of the main channel.

The channel configuration in the eastern side of the Central Basin is a major constraint to lagoon circulation, tidal flow velocities, and to fluvial stormwater runoff. Along Manchester Avenue, in the vicinity of Ocean Cove Drive, the 50 ft wide lagoon channel meanders from North to South across the entire lagoon. The channel narrows to 25 ft wide and begins to dissipate as it meanders back Northward across the entire lagoon again to pass under the I-5 Freeway bridge.

Purpose. The purpose of this project is to facilitate fluvial stormwater runoff, promote flushing of organic particulate and fine sediments accumulated in the main lagoon channel, and to encourage scouring of marine sediments accumulated in the railroad channel and ocean inlet. This project will also facilitate upstream penetration of tidal saline waters to the East Basin.

Objectives. Dredge a new 100ft wide channel. Enhance direction and flow rate of stormwater fluvial runoff to the ocean inlet and circulation of tidal salt water to the East Basin.

Approach. Slurry dredge a new channel Westward from the I-5 Freeway bridge, South of the riparian stand at the foot of Ocean Cove Drive, and connect to the main channel adjacent to Manchester Avenue on the North side of the Central Basin. The new channel will be dredged to a width of 100 ft, depth of -4 ft NGVD, and about 1,350 ft in length. The project will yield approximately 34,000 yd3 of sediment. The proposed route of the new channel will eliminate about 3.1 acres of existing cattail habitat.

Monitoring and Remediation. Channel flow velocities, sediments, and water quality conditions will be monitored at both ends of the new channel before and after the project to document the effects of the new channel. The sedimentary characteristics and status of the benthos at both ends of the proposed channel in the bed of the existing channel, and condition of the adjacent marsh habitat will be evaluated before and after the project.

Project 15. Deepen and widen portions of the main channel

Project 16. Straighten portions of the main Channel.

Project 17. Manage input of point & non-point source pollution discharge to the lagoon.

The San Elijo Lagoon has been listed as a 303d impaired waterbody by the Environmental Protection Agency and the California Regional Water Quality Control Board. The reasons for the listing are excessive nutrients and sedimentation, which occurs due to large amounts of non-point and point source pollution entering the lagoon. The historical streams that feed the lagoon were ephemeral but now flow continuously due to expanded development throughout the watershed.

Purpose. The purpose of this project is to eliminate the impaired waterbody status of the lagoon by means of several projects and by implementing the recommendations listed in the Soil Conservation Service 1993 *Non-Point Source Pollution Management Plan.*

Objectives. To implement Projects 1, 11, 12, 14, & 16 which will increase tidal flows to areas that currently undergo eutrophication and to eliminate any large sources of pollutants (i.e. nutrients and freshwater). Then implement a monitoring program to identify other sources and remove them on a case by case basis.

Approach. The approach for the projects is outlined in each of the individual sections. For pollution that is entering the system via the tributaries of storm drains the approach will be to start with the large sources and implement a monitoring program to begin to single out the others. Additionally, the City of Escondido is currently proceeding with an intermittent Live Stream Discharge project from their Hale Ave. Wastewater treatment facility. The current plan is to discharge tertiary treated water during high rain events. This nutrient laden water will flow into the lagoon and become trapped if the above stated projects are not completed. The East Basin will be impacted the most because runoff water becomes impounded before draining slowly into the central basin. During the spring of 1998 approximately 300-400 acre ft of water was trapped for 3 months until it drained or evaporated. This impoundment will have a direct result on the endangered California Least terns and Belding's savanna sparrows. The increased nutrients and freshwater will most likely shift plant community types and effect the remnant saltmarsh and salt pans that currently exist in the East Basin. The approach for this plan (derived by the San Elijo Lagoon Conservancy, USF&WS, CDF&G, The County of San Diego, and EPA) is to charge Escondido $200,000 per year for the five year permit regardless of any spill events. There will also be a charge of a certain amount per gallon if a spill does occur. After the five year permit period is up if the City doesn't expand the outfall and continues to maintain the Live Stream Discharge Permit the cost goes up 25% every five years. The money received will go towards the above stated projects to eliminate the 303d listing.

Monitoring and Remediation. Once the projects described above have been completed the lagoon will be monitored on a monthly basis. Areas that have been identified as "hot spots" and corrective action has taken place additional monitoring will occur to ensure that the action has worked. This monitoring will occur just after a rain storm where a dry

period has preceded it by 20 or more days. Corrective remediation will take place if levels exceed the target value.

Refer to Hard copy for charts

Project 18. Dredge entire west basin to improve tidal flows and tidal prism

Project 18. Dredge West Basin to improve tidal flows and tidal prism.

Tidal flushing of the West Basin is very poor. Circulation is constrained by shallow narrow channels south of the railroad bridge and behind the restaurants, an East-West berm created by installation of the ocean sewage outfall pipe, and installation of a sewage pipe from Solana Beach to a sewage pump station at the South end of the West Basin. Tidal flushing only occurs during high spring tides. This project would include Project 4.

Purpose. The purpose of this project is to improve tidal flows throughout the West Basin and to increase sediment scouring in the ocean inlet and railroad channel by increasing the tidal prism in an area as close to the inlet as possible.

Objectives. Facilitate inlet and railroad channel scouring by increasing the lagoon tidal prism. Increase tidal circulation and flushing throughout the entire West Basin. Open the southern closed, stagnant end of the basin to tidal flushing. Convert present degraded intertidal sediments to a combination of aerobic, intertidal and subtidal habitats. Increase benthic productivity and forage base for birds and create subtidal fish habitat.

Approach. Dredge the entire West Basin to a depth of -3 ft NGVD, i.e. 5 ft below the existing grade. Dredge a 100 ft wide channel at the site of each of the flow obstructions mentioned above. Dispose of top 1-2 ft of fine sediments by trucking. Use the bottom 3-4 ft of dredged sand for beach replenishment at Cardiff State Beach . Slurry pump sediments for beach replenishment via a new pipe installed under the coast highway. The final dredging plan will have to include engineering considerations for maintaining appropriate intertidal slopes adjacent to Highway 101 and the railroad berm, and for the long term protection for the ocean outfall pipeline and the Solana Beach sewer pipeline. The project will involve dredging approximately 209,000 yd3 of sediment from the entire basin. Forty percent of this material is assumed to be fine sediment and 60% is assumed to be appropriate for beach replenishment. The basin at the South end of the West Basin isolated from the lagoon by a man-made berm. The main impact to this area would be to exotic plant species and some saltmarsh plant species.

Native Species	**Exotic Species**
Saltmarsh Plants:	
Salicornia virginica ^	*Carpobrotus edulis* **
Frankenia salina +	*Raphanus sativus*
Jaumea carnosa +	Annual grasses

Monitoring and Remediation. The topography of the West Basin will be surveyed before and after the project to document completion of the dredging project as designed. Tidal currents in the vicinity of the flow restriction sites will be measured in order to assure protection of existing pipelines and restaurant property. Rock rip-rap may have to be installed at the flow restrictions points to eliminate any local bank erosion. The sedimentary characteristics and status of the benthos in the basin sediments and the condition of the adjacent marsh habitat will be evaluated before and after the project.

Project 19. Enhance habitat for sensitive avian species.

San Elijo Lagoon provides one of the richest coastal habitats for birds in San Diego County. Because the Pacific Flyway crosses the reserve, it is extremely important that we continue to supply a healthy and safe habitat for these migratory birds.

Purpose. San Elijo Ecological Reserve has had over 20 sensitive bird species located throughout the entire reserve and over 290 different species have been seen in the reserve. Because the reserve is an important stop for the Pacific Flyway it is important to ensure that the most sensitive species have the appropriate areas that they need to survive.

Objectives. This project will cover the six most sensitive avian species found in the reserve (listed below) and will focus on enhancing the existing habitat and creating new habitat as well as ensuring that the proper food base is available.

Approach. This "project" will be accomplished by implementing several other projects that are described in this report tat are also designed to increase the habitat and create new habitat as well as ensure the proper food base is available. The birds and supplemental projects are as follows:

Bird Species	Associated Projects
19-1 Light-footed clapper rail.	1,3,4,5,6,9,11, & 12
19-2 California least tern.	1,4,6,10,11,12,15, & 24
19-3 Snowy plover.	1,2,6,10,11,12,15, & 24
19-4 Least Bell's vireo.	6 & 7
19-5 California gnatcatcher.	6
19-6 Belding's savanna sparrow.	1,6, & 17

Monitoring and Remediation. Monitoring will be accomplished by conducting pre and post construction monitoring surveys. Data will show whether or not remediation is needed. If the data point to one or several declines in any species then the focus will turn to increase the attention towards that species. Remediation may involve additional dredging or planting. Surveys will be conducted weekly for the first year and every month for the next four years preceding a major project. This will ensure that the birds are being censored during both migration and nesting periods.

Project 20. Lengthen Existing Railroad Trestle.

Flood runoff and tidal flows in the lagoon are constrained by the presence of the existing railroad trestle and adjacent berms. The railroad trestle and berm, like the Highway 101 and I-5 Freeway bridges and adjacent berms, are choke points that constrain the pathway and volume of water that can flow through the lagoon. Presence of numerous trestle pilings also reduces tidal flows. Recently, the Santa Fe railroad has expressed an interest in the feasibility of double-tracking the railroad across the lagoon. A double trestle would restrict tidal flows even further. One alternative could be to construct a new double trestle across the entire lagoon and remove the existing trestle and solid berm. This alternative would greatly increase the tidal circulation throughout the lagoon and substantially reconnect the West and Central Basins.

Purpose. The purpose of this project is to increase the rate of dissipation of flood flows and tidal flushing and circulation by eliminating one of the major flow choke points in the lagoon.

Objectives. Investigate the feasibility of lengthening the existing railroad trestle or construction of a new, longer trestle at a new site further south. Investigate the feasibility of eliminating the existing trestle and berm and construction of a new trestle across the entire lagoon.

Approach. Meet with the Santa Fe Railroad to outline possible alternatives. Evaluate likely impacts from construction of each alternative. Evaluate potential benefits of each alternative to improving the lagoon hydrology, mixing, and circulation. Develop a hydrological model to assess the magnitude of improved tidal flushing for each alternative. Additional field surveys will be required to document the kinds and status of existing habitats and presence of and use by any threatened or endangered species along the footprint of the proposed alternatives.

Construction of a new trestle across the entire lagoon and removal of the existing trestle and berm enhances the feasibility of relocating the existing ocean inlet to a new site south of the existing restaurants and ocean outfall pipeline (see Project 22).

Monitoring and Remediation. The construction corridor will have to be monitored to assure confinement of construction impacts to the right-of-way easement area for both construction of the new trestle and removal of the existing trestle and berm. This will include limiting loss of existing habitats and control of construction impacts on water quality conditions.

Refer to Hard copy for charts

Project 20. Lengthen existing railroad trestle

~~Project 21. Add Culverts Through Railroad Berm.~~

Not included in this report.

Project 22. Relocate Ocean Inlet and Dredge New Central Channel

Interest in relocating the existing ocean inlet has emerged from the public's concerns for the increasingly degraded condition of the lagoon contrasted with the rapid improvement of the lagoon when tidal flushing is restored, local complexity of hydraulic conditions in the vicinity of the present ocean inlet, public health when water quality conditions stagnate, the possibility that the Highway 101 bridge may have to be replaced soon, and from the expectation that a new, relocated ocean inlet must be better than the present inlet. This project is an expensive, major undertaking and would require numerous environmental and engineering studies. It is also likely to require extensive dredging in the West and Central Basins, and may not be cost effective. Part of the justification for construction of a new ocean inlet would be to enable a "self-sustaining" tidal flushing system. This would require increasing the lagoon tidal prism substantially by undertaking major lagoon dredging. "Self-sustaining" tidal flushing is not completely achievable since other similar, local jettied lagoons (e.g. Agua Hedionda, Batiquitos) require regular maintenance dredging of marine sediments from their western basins.

Purpose. The purpose of this project is to determine the feasibility, site, design, and construct a new ocean inlet at another location on Cardiff Beach, and terminate use of the present ocean inlet.

Objectives. Assess overall project feasibility.

Approach. This project will minimally include the following components: Jetties, new coast Highway 101 bridge, new railroad trestle, relocation of powerlines and pipelines, and a new lagoon embayment and connecting channels. The new ocean inlet would probably be located south of the existing restaurants and the ocean sewer outfall pipeline. Evaluate lagoon and oceanographic aspects of alternative inlet locations. Determine if jettied ocean inlet is required. Evaluate extent of lagoon dredging needed.

Monitoring and Remediation. Monitor effects of construction and operation of new ocean inlet. Evaluate effects of jetties on nearshore coastal processes, changes in lagoon tidal prism and circulation, water quality, stormwater runoff, and lagoon community enhancement. Evaluate ecological value to the lagoon of constructing a new ocean inlet. Compare environmental effects of maintenance dredging for the existing and for the new ocean inlet. Use lagoon long term monitoring program results (see Project H) to assess ecological changes by comparing conditions before and after the project.

Project 22. Relocate ocean inlet and dredge new Central channel

Project 23. Manage Input, Deposition, and Decay of Marine Algal Wrack

During years with high productivity of marine algal macrophytes high wave conditions can deposit substantial algal biomass on the beach adjacent to the mouth of the lagoon. Flooding spring tides and waves can transport large volumes of drift algae through the inlet and into the main channel where it sinks and is deposited in the deeper waters. The transport of drift algae is also frequently accompanied by a rapid transport marine sand into the main channel. Rapid sand deposition often buries the drift algae, accelerates its decay, and produces hydrogen sulfide which is toxic to marine life. This problem is then exacerbated during neap tide periods of reduced tidal exchange.

Purpose. The purpose of this project is to manage the marine algal wrack that accumulates in the main channel adjacent to the railroad track between the lagoon inlet and the railroad trestle

Objectives. Reduce the accumulation of marine drift algae in the main channel.

Approach. Visually monitor the accumulation of drift algae along the beach on the open coast and in the main channel. Periodically remove algal biomass deposited in the main channel by use of nets operated from the shoreline.

Monitoring and Remediation. Conduct visual inspections to track rate of accumulation of algal biomass.

Project 23. Manage input, deposition, and decay of marine algal wrack

Project 24. Enhance dune habitat.

Dune/Coastal Strand habitat is one of the most disturbed habitats in San Diego County. All existing dunes in San Diego have either been destroyed or disturbed by means of development. This habitat supports several threatened species and provides a natural buffer from the ocean. The development of highways, railroads and other structures have isolated all dune habitats in San Diego county except for Tijuana Estuary. It is vital to the survival of this habitat to restore all affected areas before they have diminished completely.

Purpose. The purpose of this project is to increase the diversity of the Coastal Strand and Dune habitat located in the Southwest corner of the West Basin.

Objectives. To remove all exotic plant species (especially *Carpobrotus edulus*) from the area and to allow the existing seed bank appropriate time to become established. The area will also be graded to enhance nesting and breeding area for the endangered California Least Tern and the Snowy Plover.

Approach. The exotics will be removed via manual means (hand pulled). After all plants have been pulled and the underlying seed bank has been given enough time to propagate then areas with low diversity will be planted and irrigation may need to be applied. Some areas will be designated for nesting sites. These areas may need some minor grading to satisfy the requirements for nesting of the endangered California Least Tern and the Snowy plover. It will be recommended that fencing be placed over the entire area to inhibit predation and human interference with the area. The fencing will be as per California Fish and Game requirements. Areas that are designated for nesting will be void of vegetation and have the proper slopes into the water. It is recommended that Project 12 and 4 or 18 be accomplished before nesting areas are constructed to ensure a proper food base for the birds.

Monitoring and Remediation. The area will be monitored for a reoccurrence of exotic species. If some are found the same manual means will be used. Use of herbicides will be restricted due to damage that may occur to the underlying seed bank. Predation will be monitored and additional means will be established as needed. Plant rehabilitation will be monitored for diversity and % cover.

Project 24. Enhance dune habitat

4.4 PRESERVATION PROJECTS

> ***"The protection of ecologically important wetlands and other aquatic resources in perpetuity. Preservation may include protection of upland areas adjacent to wetlands as necessary to ensure protection and/or enhancement of the aquatic ecosystem".***

Project 25. Acquisition of Property

The San Elijo Lagoon reserve is under constant threat from development. The direct and indirect effects of development occurring throughout the water shed can cause significant chronic and cumulative changes to the lagoon ecosystem. By acquiring important lands around the reserve and elsewhere in the watershed we will be adding the important buffers needed to protect the reserve, preserve important habitat lands, and reduce future costs of remediation.

Purpose. San Elijo Ecological Reserve is approximately 900 acres and contains 8 different plant communities. The reserve has been under constant pressure from development for the last 50 years. Currently, the border of the reserve is almost 100% built out, but development throughout the watershed and more directly along the tributaries is on the increase. There are several parcels of critical land that would add the necessary buffers to the lagoon and are therefore recommended for purchase. Along with these recommended parcels, other areas that border the tributaries should be looked at for protection to help alleviate the non-point source pollution and sedimentation that is affecting the lagoon. These areas will also act as a wildlife corridor for the reserve.

Objectives. To acquire important lands through donation, purchase, or conservation /biological easements.

Approach. The San Elijo Lagoon Conservancy will talk to land owners to discuss ways of ensuring the safety and preservation of their land. The Trust for Public Lands may be brought in to help in discussions to help facilitate directions that land owners may take. Fund raising and lobbying will be the means to acquire the appropriate funds to purchase titles and or easements.

Legal Requirements. The San Elijo Lagoon Conservancy will require a maintenance endowment for all lands that are turned over to them. The Trust for Public Lands or the Resource Conservation District can help facilitate the process on determining the amount needed to accomplish this task. Land owners will also receive direction on ways to best benefit by means of a tax break in this transaction.

5.0 ENHANCEMENT PLAN SUPPORT PROJECTS

The projects described in this section provide important support for the field projects described in section 4.0. These projects fill critical data gaps or enable final design or are important to gain regulatory approval of the primary field projects.

Project A. Regulatory Agency Review and Permitting (EIR/EIS)

Implementation of a large enhancement program at San Elijo Lagoon would require regulatory and public review and a permit if the proposed program includes substantial dredging and disposal of sediments. This process will include an open assessment of the potential environmental effects of the proposed projects and an evaluation of alternative approaches.

Purpose. The purpose of this project is to prepare an environmental assessment of the impacts of alternative approaches to enhancing San Elijo Lagoon.

Objectives. Identify the mix and scope of projects that will best enhance San Elijo Lagoon and have the least impacts on the existing habitats.

Approach. Based on the composition and scope of the Enhancement Plan to be implemented and severity of any anticipated impacts, determine if permits are required. Consult with regulatory agencies, prepare application, prepare public notice, hold public hearings, draft environmental document, respond to comments, and finalize the scope of the proposed Enhancement Plan and the environmental review document. This report will incorporate the results of the Historical and Current Environmental Baseline Conditions study (see Project B) as a basis for evaluating proposed project impacts. It will also utilize the results of most of the projects outlined in Sec. 5.0.

Monitoring and Remediation. Not included.

Project B. Historical and Current Environmental Baseline Conditions.

Due to the long-term public interest in San Elijo Lagoon, a substantial quantity of valuable environmental information has been prepared. Much of this information was recently assembled into an Enhancement Plan. However, in their present form these data are inadequate to allow for completion of an acceptable environmental impact assessment (e.g. EIA, EIR, EIS).

Purpose. Assemble a contemporary description of historical information and events, and recent environmental monitoring data in order to establish a more complete baseline of information , identify data gaps, and facilitate estimation of expected environmental impacts of proposed projects.

Objectives. Characterize the composition, distribution, abundance and functioning of lagoon biological communities. Evaluate the condition of the existing habitats and their ecological importance. Assess the present status of threatened and endangered species using these habitats.

Approach. This project will create a comprehensive summary of historical and current environmental monitoring information. The historical data sets will be reviewed and assembled into an overall characterization of the status and changes that have accrued, including man induced effects. This report will also review summarize the results of the more recent and on-going environmental monitoring programs conducted over the last 5 years. This baseline report together with the results of additional new studies will be used to assess the environmental impacts of the proposed enhancement program (see Project A).

Monitoring and Remediation. Not included.

Project C. Special Field Studies.

Implementation of an enhancement program at San Elijo Lagoon will require generation of new information to answer specific data needs and to fill data gaps. Anticipated areas that will require special field studies include the following studies.

- Sediment coring to characterize sediment types and volumes prior to dredging specific sites.
- Characterization of surficial sediments throughout the lagoon.
- Develop a hydrological model of the lagoon to study the effects of channel deepening and reconfiguration, and to evaluate changes in the salinity regime.
- Documentation of lagoon water quality response to fluvial runoff.
- Documentation of lagoon response to urban stormwater runoff.

Purpose. Conduct specific studies to provide information needed to finalize the design, mix and scope of projects to enhance San Elijo Lagoon.

Objectives. Obtain new data needed.

Approach. Identify data gaps, and design and implement studies to enable finalization of proposed enhancement projects. Each project will be carefully designed and described in detail.

Monitoring and Remediation. Monitor each project to assure that the data are acquired appropriately and proper analyses are conducted.

Project D. Alternative Project Design.

The candidate projects listed in Table 3-1 and described in Sec. 4.0 are presented as individual stand alone projects. The individual projects need to be integrated into a set of alternative wetland enhancement design plans. Each design plan would be comprised of a group of projects that make both ecological sense and hydrological sense.

Purpose. The purpose of this project is to prepare a series of habitat maps that illustrate a set of integrated enhancement plan alternatives for the entire lagoon.

Objectives. Create and restore tidal wetlands, with extensive intertidal and subtidal areas. Provide for maximum overall ecosystem benefits, downstream fish values, regionally scarce habitat, and local ecosystem diversity. Minimize impacts to existing functioning wetlands and other sensitive habitats. Produce and support wetland-dependent resources. Provide for rare or endangered species habitat. Provide for restoration or reproductively isolated populations of native species. Provide for a 100 ft wide upland transition protective buffer.

Approach. Develop a GIS based mapping system from aerial photographs of the existing condition of the lagoon. Prepare a habitat map for each proposed enhancement plan alternative. Suggested design plan alternatives include the following:

- Ocean inlet maintenance only.
- New ocean inlet .
- Maximum acreage.
- Improved basin circulation
- Stormwater runoff management

Monitoring and Remediation. Each alternative design plan will be compared to the existing habitat and evaluated in terms of both impacts and beneficial effects to the existing habitat and to the lagoon as a whole ecosystem. Potentially impacted areas will be subsequently evaluated within the framework of a formal public and regulatory environmental review (EIR/EIS) if needed.

Project E. Plant Community Mapping & Aerial Photography.

In the last five years remote sensing technology has brought about a change in the way that whole ecological systems can been monitored. Aerial photographs with the added benefit of ADAR imagery has brought about a new way for tracking changes in plant communities. By combining spectral digital imagery and traditional mapping methods we will better understand the spatial and temporal scales of environmental changes as they occur rather than after changes have already taken place.

Purpose. The purpose of the plant community mapping is to track and monitor current and future trends in the 8 different plant community habitats.

Objectives. This project will give the management and monitoring team a current view of the plant communities in the reserve and how they respond to the changes caused by the proposed projects. It will also enable mapping of changes in the distribution and abundance of exotic species.

Approach. The plant community mapping will take place in two parts. The first part will contain traditional ground surveys in areas where invasive species have become established. Here, survey transects will be placed and % cover and other measurements will be taken on a quarterly basis. These data will allow tracking the rates of expansion of invasive species as well as the change in species composition as it occurs. The next level of sampling will contain ADAR aerial imagery and ground truth measurements. This method will allow the whole lagoon to be sampled and a general plant community map to be developed. This method will also allow for the long term monitoring and development of each of the plant communities as each project is completed. The aerials will be taken in August and in February. Photograph surveys will continue for 5 years after the last large project (dredging, revegetation,) is completed.

Monitoring and Remediation. If changes in vegetation are occurring and not appearing in the data, but are visible by other means then the program will be increased.

Project F. Ocean Inlet and Non-Structural Alternative Plan.

Due to the presence of valuable existing habitat, San Elijo Lagoon is not a candidate for a massive dredging project. Consequently, continuous lagoon tidal flushing will have to be accomplished by actively maintaining an open ocean inlet. This can be accomplished by developing and implementing a significantly less expensive intermittent non-structural management program in the area of the lagoon inlet.

Purpose. The purpose of this study is to develop a strategy for sustaining tidal flushing of the lagoon by actively managing the structural characteristics and hydrology of the ocean inlet and the main lagoon channel adjacent to the railroad.

Objectives. Develop a reliable, cost effective inlet and channel maintenance strategy and methodology. Test and refine the methodology as time goes on.

Approach. Review the existing field data and acquire additional field information to develop a specific plan for intermittent maintenance of the ocean inlet and main lagoon channel by removal of accumulated marine sediments and cobbles. Data needs will include the following: Changes in inlet and main channel characteristics, rates of sediment sand cobble accumulation, current velocities and water level changes at the railroad and I-5 Freeway bridges, lagoon water quality conditions, local wave conditions and effects of Cardiff Reef, sediment characteristics, ocean tidal levels, and fluvial input. The plan will recommend methods for removal and disposal of marine sediments and cobbles in the area of the ocean inlet (e.g. conventional earth moving equipment) and marine sediments from the railroad channel (e.g. slurry pumping and/or elutriation) during ebb tidal flows. The frequency of maintenance will be planned to take advantage of winter stormwater fluvial runoff to assist in removal of accumulated sediments. Stormwater fluvial flow through the lagoon will also have to be managed more aggressively (see Projects 14, 16 and 17). Reduced dissolved oxygen and high water temperatures might trigger a summer inlet maintenance effort, while prolonged reduced salinity might trigger a winter inlet maintenance effort. Inlet maintenance may also be triggered by closure of the inlet from development of a sand and cobble berm across the lagoon mouth due to high wave conditions.

Monitoring and Remediation. The monitoring of the inlet will take place both pre and post opening to determine the amount of material that was removed. This baseline will be needed to determine amounts needed to be removed at the next scheduled maintenance. Through this process a baseline of date will be collected in which amount of material removed, time (date) of opening, and duration of the opening as well as the tidal prism. This will allow us to fully analyze and reform the procedures as time goes on. The ultimate goal is to not let the inlet close for more than one week in the winter, spring, or fall and two days in the summer.

Project G. GIS and Database Management and Analysis.

San Elijo Lagoon Conservancy (SELC) will take the lead in maintaining the database for all projects that are approved for the lagoon. Whether the project is for mitigation or an agency sponsored project. The SELC will use a GIS database format along with spreadsheets that will function with current statistical programs such as SAS. All raw data will be available for agency use, but will not be released to the public unless it is for a mitigation project or comes from a SELC report. The SELC will maintain all rights to the raw data. Any group wishing conduct their own studies must first get the approval of the County of San Diego Department of Parks and Recreation and the California Fish and Game.

All analysis of the data will be done using current methods and standards approved by the Environmental Protection Agency or by other acceptable methodologies. All critiques of the data will be given a thorough review by our scientific committee and upon approval, the raw data will be released to the group. No group may publish from the existing raw data set without the approval of the Scientific Advisory Board.

The San Elijo Lagoon Conservancy's policy is to support all projects with the appropriate scientific knowledge and to monitor each project with the proper guidelines.

Project H. Short Term and Long Term Environmental Monitoring.

Purpose. The purpose of the environmental monitoring program is to quantitatively track the long-term changes observed within the lagoon wildlife communities and to provide a mechanism for differentiating natural variability in measured parameters from changes due to pollution and other environmental impacts

Objectives. . The objectives of this project are to be able to track long-term trends in environmental health of the lagoon, effects of short –term pollution pulses, and to measure the benefit of implemented creation, restoration or enhancement mitigation projects.

Approach.

The approach will be defined further to meet the needs of the regulatory agencies for specific projects. As a beginning point, the long-term environmental monitoring program will follow the general wetland monitoring guidelines outlined by PERL (1990), and utilize the sampling protocols recommended by the ASTM (1998). PERL (1990) discusses sampling methods pertaining to hydrology, topography, sediment, nutrients, plants, animals, and bacteria.

6.0 ACREAGE AND PHASING OF PROJECTS

The estimated acreage and dredge volume associated with each proposed project is summarized in Table 4-1 by lagoon basin and by type of project.

The Enhancement Plan should be implemented in phases and monitored so that it can be verified that the completed projects are accomplishing their intended objectives. This approach will probably reveal that it will be possible to eliminate certain projects scheduled for subsequent phases due to successes of completed projects and thereby reduce the overall program costs. A suggested plan for phasing of the proposed projects is given in Table 4-2.

It is also possible to link several projects together where, for example the result would make better hydrological or ecological sense, or where reductions in mobilization and demobilization of equipment could be achieved. Examples of enhancement strategy topics for grouping of projects are as follows:

- Removal of invasive plant species.
- Maximum subtidal acreage.
- Lowest total cost with maximum improvements.
- Maximum enhancement credits.
- Hydrological improvement.
- Ecological benefit.

Alternatively, the projects could be prioritized on the basis of type of project, e.g. creation, restoration, enhancement or preservation of habitat. The San Elijo Lagoon Conservancy will work with interested organizations to determine the best mix of projects to implement a specific enhancement strategy.

7.0 ESTIMATED PROJECT COSTS

The location of each project is presented in a series of individual project maps, shown at a scale of 1" = 100 ft. in Appendix 2. The acreage involved in each project was calculated by measuring the area of each project with a planimeter. The measured areas included the total area (project perimeter) and the wetland area (i.e. elevation between 2 - 4 ft NGVD). The volume of sediment to be dredged was calculated using the following assumptions:

- Slope 1:3
- New and existing channels would be dredged to a depth of -2 or -4 ft NGVD
- News basins would be dredged to a depth of -4 ft NGVD.

Costs for dredging and disposal of the dredged materials were evaluated based on the appropriateness of disposal of the sediments at various sites, e.g. in the over-dredged West Basin of the lagoon, on Cardiff Beach, nearshore, at an offshore dump site, or at an upland site. Costs for any grading of projects adjacent to upland sites, saltmarsh and slope replanting, slope stabilization, trail construction, construction management, engineering, administration, and construction monitoring were also evaluated. The unit costs assumed for various types of construction work are summarized in Table 7-1. The end product is an estimate of the total cost of each project taken individually and an estimate of the total cost per acre (Table 7-2).

Since there may be some overlap amongst the individual projects, the cost for doing all projects is not the sum of the individual projects. For example, Project 4 "Restore Tidal Flow Throughout the West Basin by Dredging a New Channel" is not necessary if Project 18 "Dredge Entire West Basin to Improve Tidal Flows and Tidal Prism" is implemented.

Table 7-1

Unit Cost			
Item	**Unit**	**Cost**	**Notes**
Mobilization/demobilization		$1,000-100,000	Allowance
Beach Disposal	cy	$5.00	Based on San Dieguito
Nearshore Disposal	cy	$10.00	" "
Offshore Disposal	cy	$18.00	" "
Upland Disposal	cy	$25.00	Order-of-Magnitude
Grading	cy	$3.00	Order-of-Magnitude
Salt Marsh Planting	acres	$20,000	Based on Batiquitos
Slope Planting	acres	$5,000	Order-of-Magnitude
Slope Stabilization	ft	$1,000	Order-of-Magnitude
Sewer Pipe Protection		$50,000	Allowance
Inlet Maintenance	yr	$100,000-200,000	Historical Data
Contingency		10%	Allowance for Restoration
Construction Management		3%	Allowance for Restoration
Engineering		6%	Allowance for Restoration
Administration		6%	Allowance for Restoration
Environmental Monitoring		5%	Allowance for Restoration

TABLE 7-2 SAN ELIJO LAGOON PROJECTS - NEARSHORE DISPOSAL

Project #	Project name	Site #	Site Name	Basin	Total Area (ac)	Wetland Area (ac)	Volume (cy)	Cost $	Notes
1	Upland Excavation	1.1	Alluvial Fan	Central	1	0.8	3,227	116,160	
1	Upland Excavation	1.2	Trailhead	Central	1.3	0.8	6,292	396,476	
1	Upland Excavation	1.3	South End	Central	1.1	0.7	2,662	71,474	
1	Upland Excavation	1.4	Southeast	Central	4.3	3.3	27,749	584,423	
1	Upland Excavation	1.5	Manchester Trail	Central	2.6	1.9	18,876	937,879	
1	Upland Excavation	1.6	Manchester Drain	Central	4.7	4.6	22,748	536,606	
1	Upland Excavation	1.7	Old Railroad Berm	Cnetral	1.1	1	6,211	523,414	
1	Upland Excavation	1-8a	Old Sewage Ponds	Central	1.4	1.4	6,776	155,706	Includes 1-8a and 1-8b
1	Upland Excavation	1-8b	Old Sewage Ponds	Central	1.5	1.5	4,840		Grading to +3 ft MSL
1	Upland Excavation	1.9	Ocean Outfall Brem	Central	0.5	0.5	3,227	70,881	
1	Upland Excavation	1.11	Isthmus	Central	0.6	0.4	1,936	45,883	
4	Dredge New Channel			West	9.1	9.1	22,022	453,159	
9A	Contract Cattails	9A-1	East	East	18.2	18.2	58,725	1,595,252	
9A	Contract Cattails	9A-2	West	Central	17.8	17.8	57,435	1,560,191	
9B	Contract Cattails	9B-1	East	East	18.2	18.2	220,220	4,303,517	
9B	Contract Cattails	9B-2	West	Central	17.8	17.8	215,380	4,208,935	
9C	Contract Cattails	9C-1	East	East	18.2	18.2	0	627,198	
9C	Contract Cattails	9C-2	West	Central	17.8	17.8	0	613,782	
10	Subtidal Dredging	10.1	East	Central	5.9	5.9	52,353	877,954	
10	Subtidal Dredging	10.2	West	Central	6.6	6.6	58,564	982,118	
10	Subtidal Dredging	10.3	Expanded	Central	35	35	310,567	5,208,203	
11	Circulation Increase	11.1	Access Road Channel	Central	5.2	5.2	16,779	281,378	
11	Circulation Increase	11.2	South End	Central	5.4	5.4	47,916	1,446,392	
11	Circulation Increase	11.3	East End	Central	2.7	2.7	21,780	365,251	Beach Disposal
12	Ocean Inlet	1.21	Inlet Dredging	West	4	4	19,360	162,334	
12	Ocean Inlet	12.2	Hydraulics Improvement	West	261	261	0	0	
12	Ocean Inlet	12.3	Hydraulics Improvement	West	261	261	0	0	
14	Cattail Channels			East	2.5	2.5	14,117	236,737	
15	Main Channel			Central	10.7	10.7	69,051	1,157,980	
16	Straighten Main Channel			Central	3.2	3.2	33,557	562,756	
18	Dredge West Basin			West	23.6	23.6	209,411	3,354,000	

8.0 LITERATURE CITED

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9.0 APPENDICES

Appendix 1. Detailed Project Location Maps

- **Map 1. Locations of Proposed Projects in the West Basin**
- **Map 2. Locations of Proposed Projects in the Central Basin**
- **Map 3. Locations of Proposed Projects in the East Basin**

Appendix 2. Detailed Project Plans

Appendix 3. Aerial Photographs of San Elijo Lagoon

APPENDIX 1

DETAILED PROJECT LOCATION MAP

Refer to Hard copy for charts

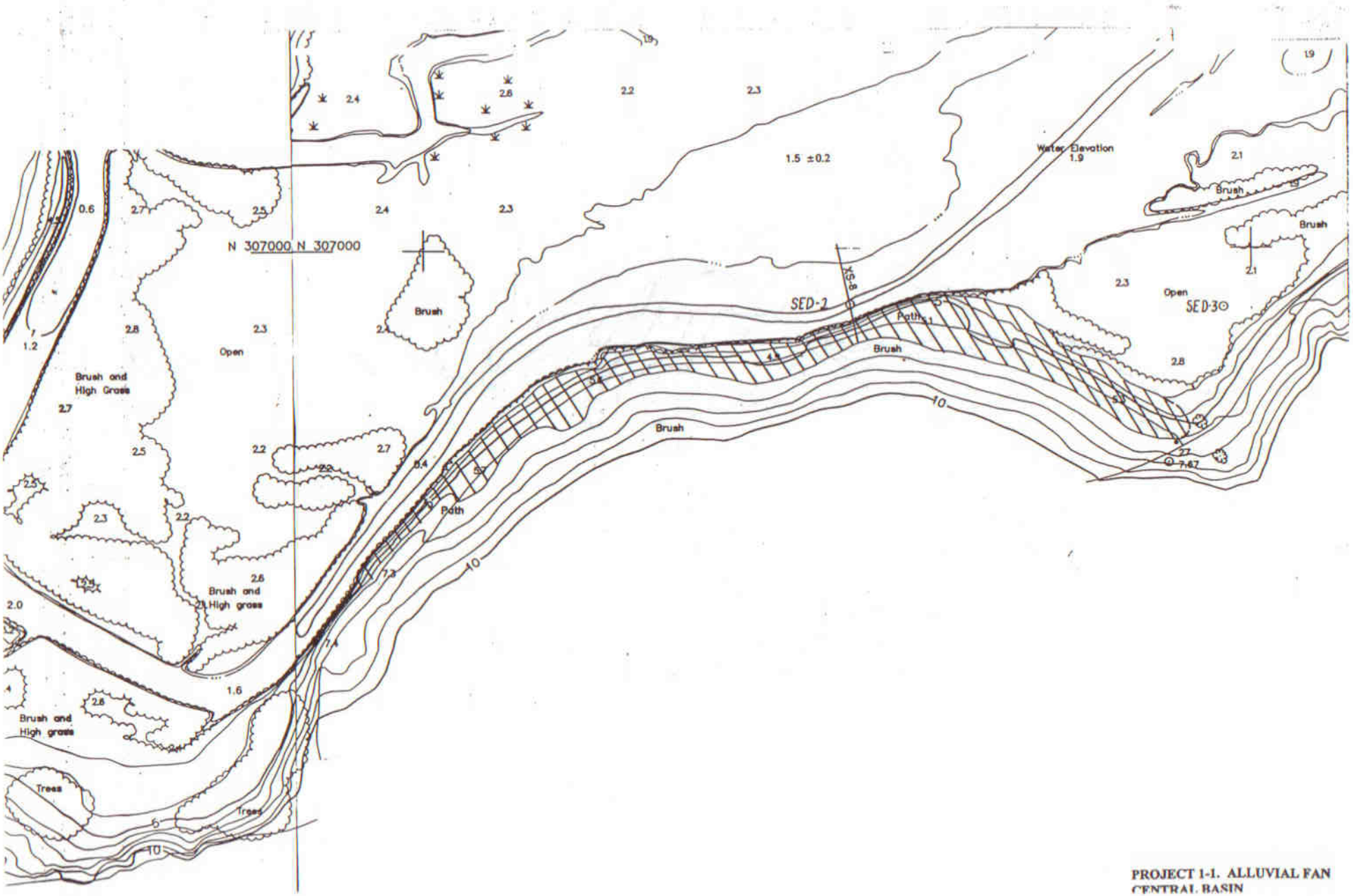
Refer to Hard copy for charts

Refer to Hard copy for charts

Refer to Hard copy for charts

APPENDIX 2

DETAILED PROJECT PLANS



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CENTRAL BASIN

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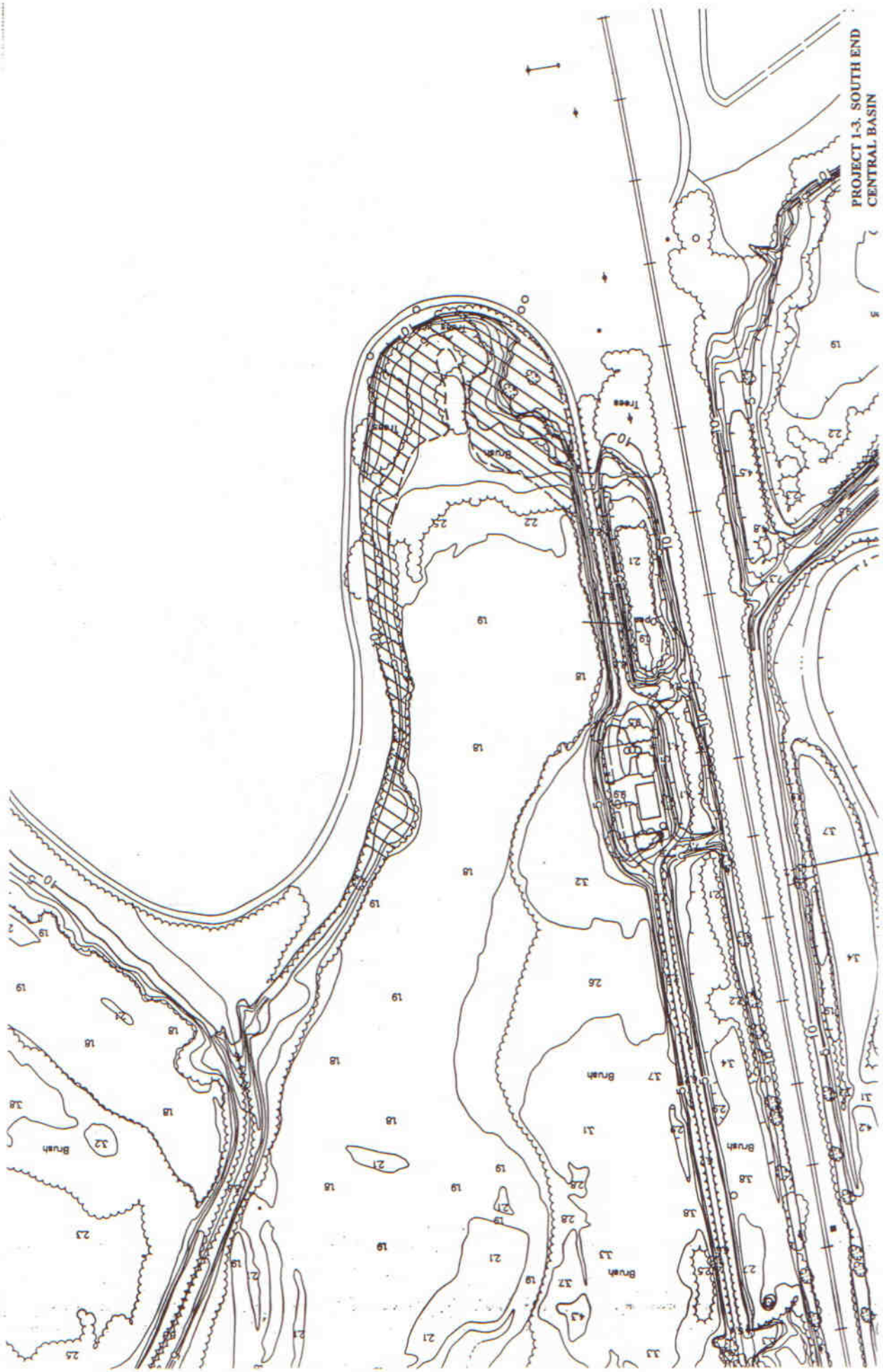

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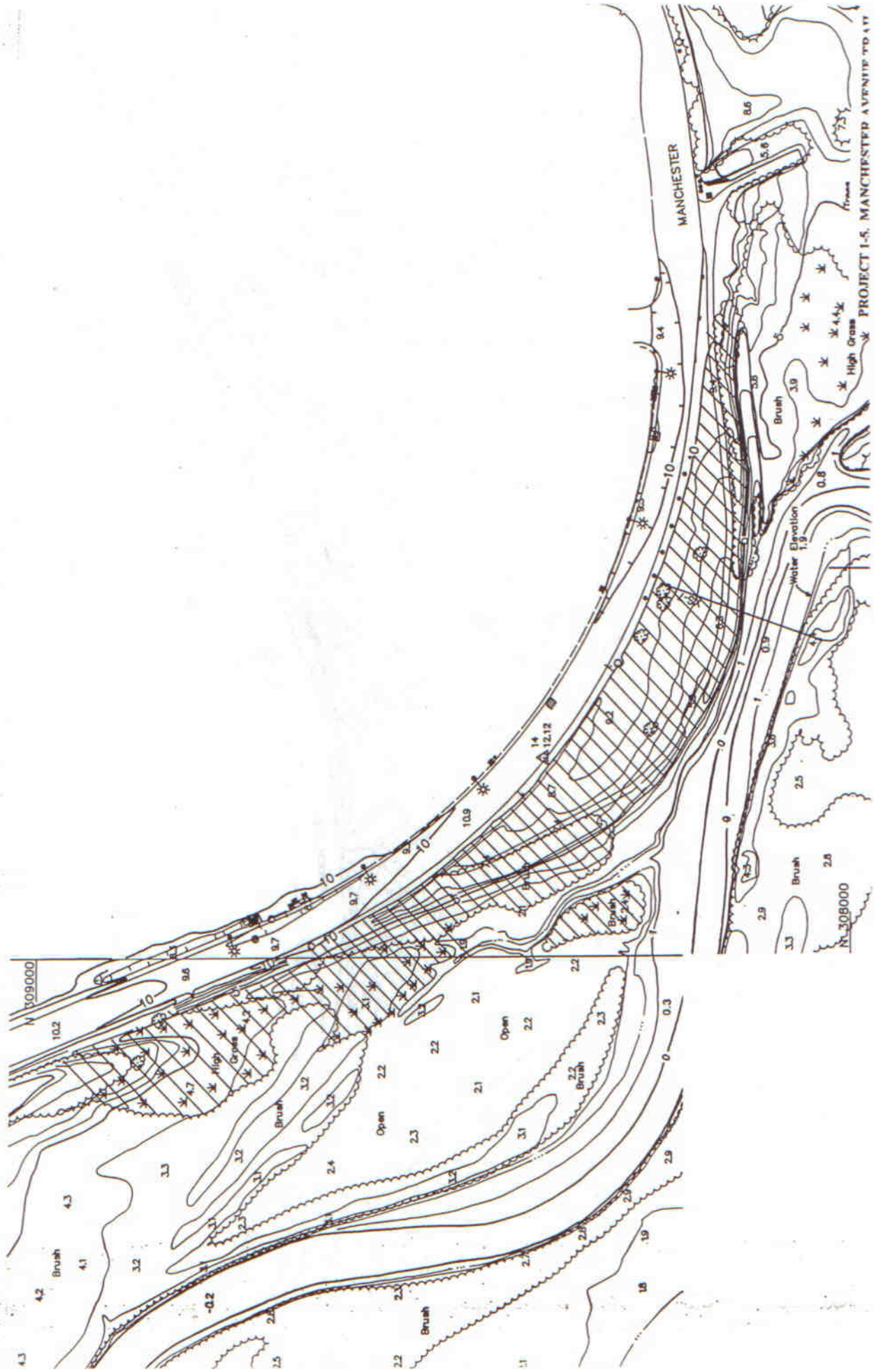

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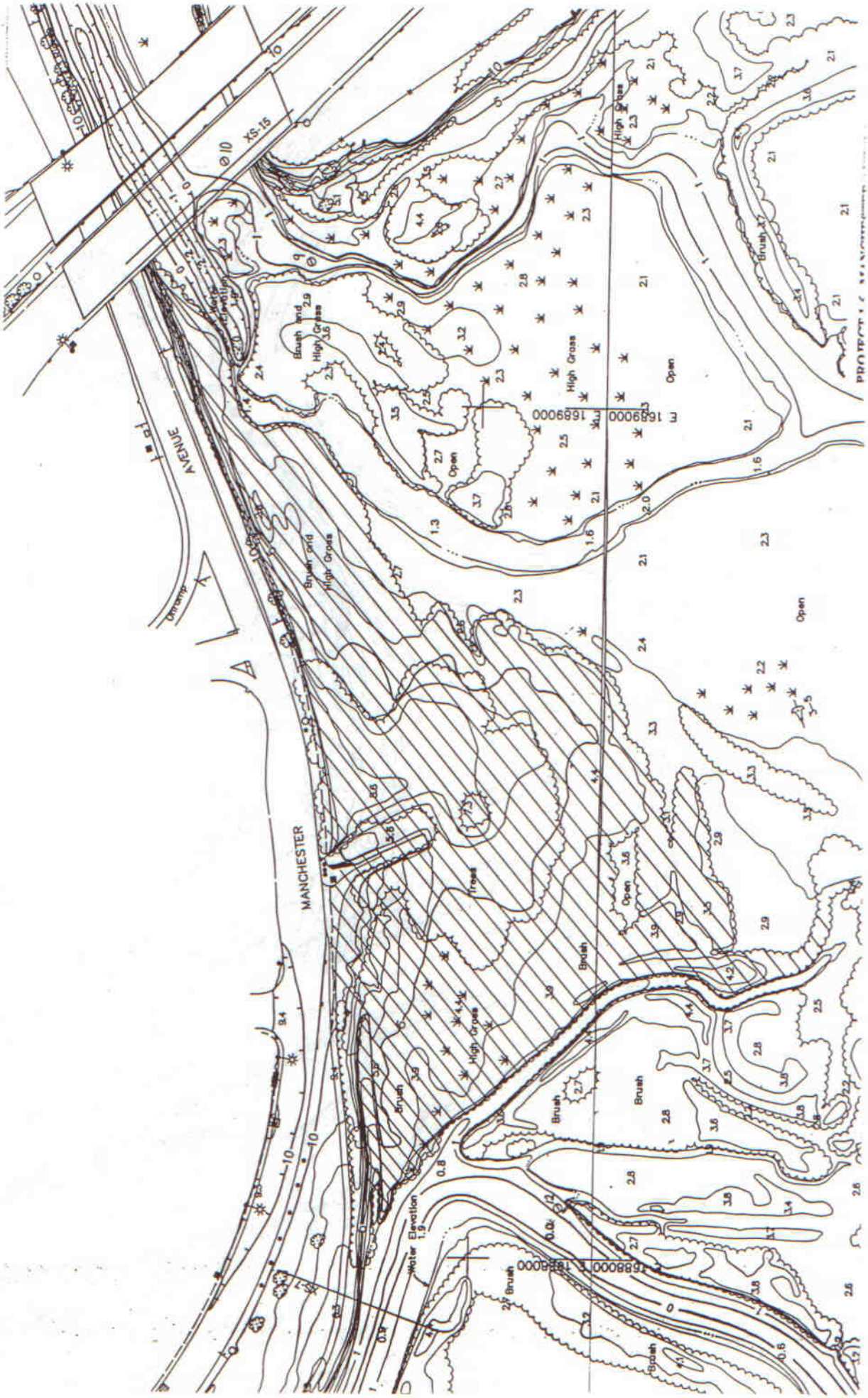

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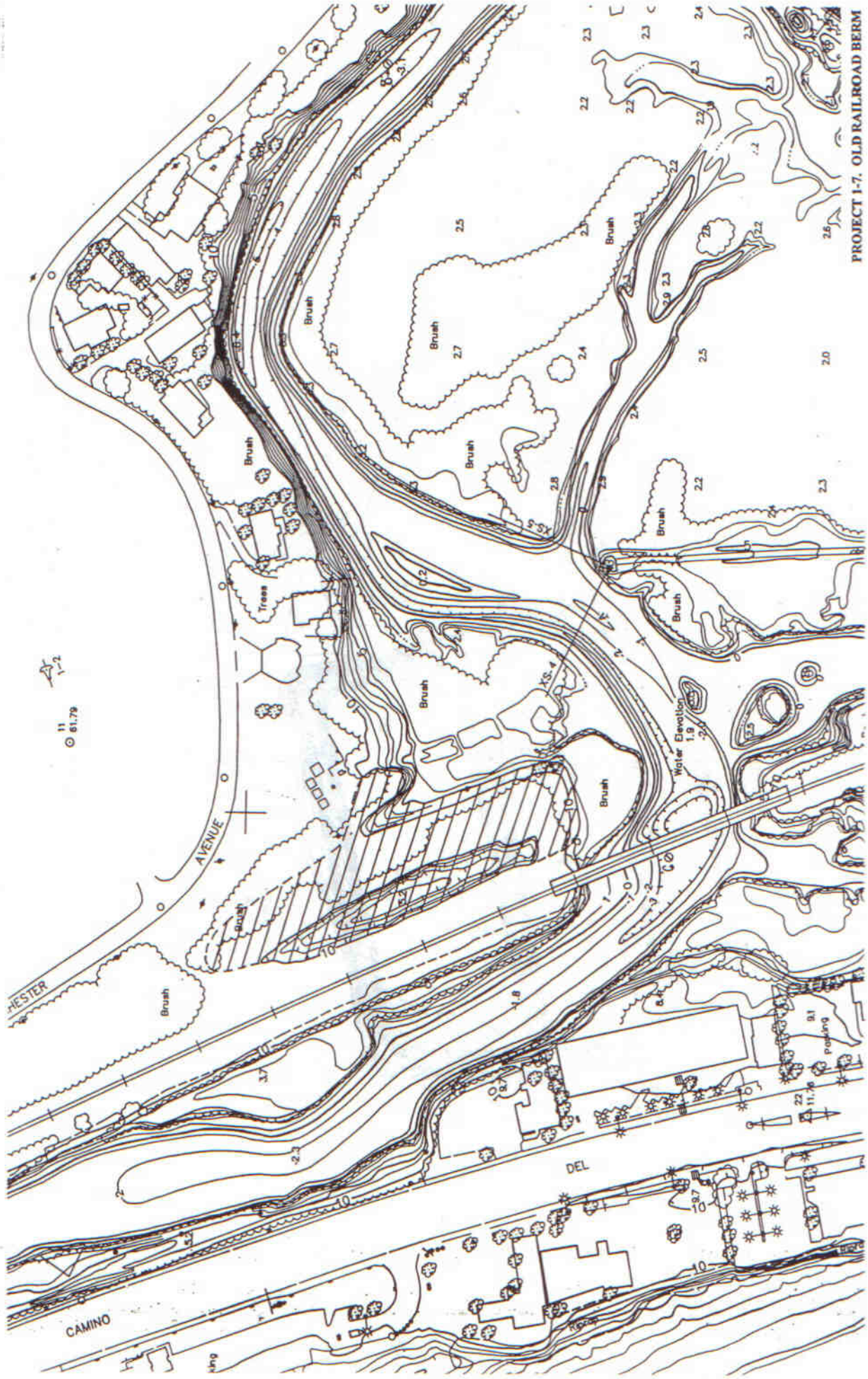

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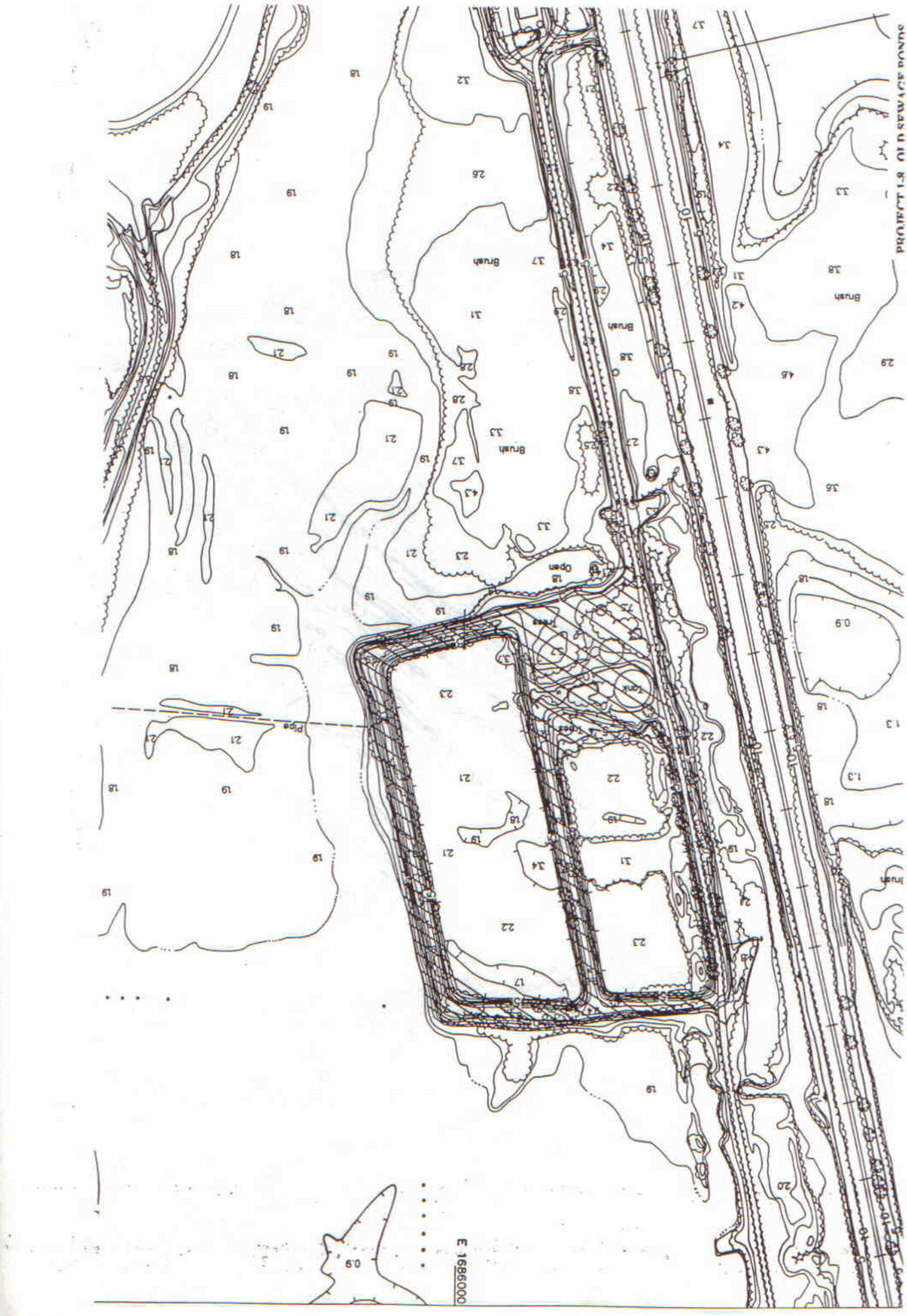

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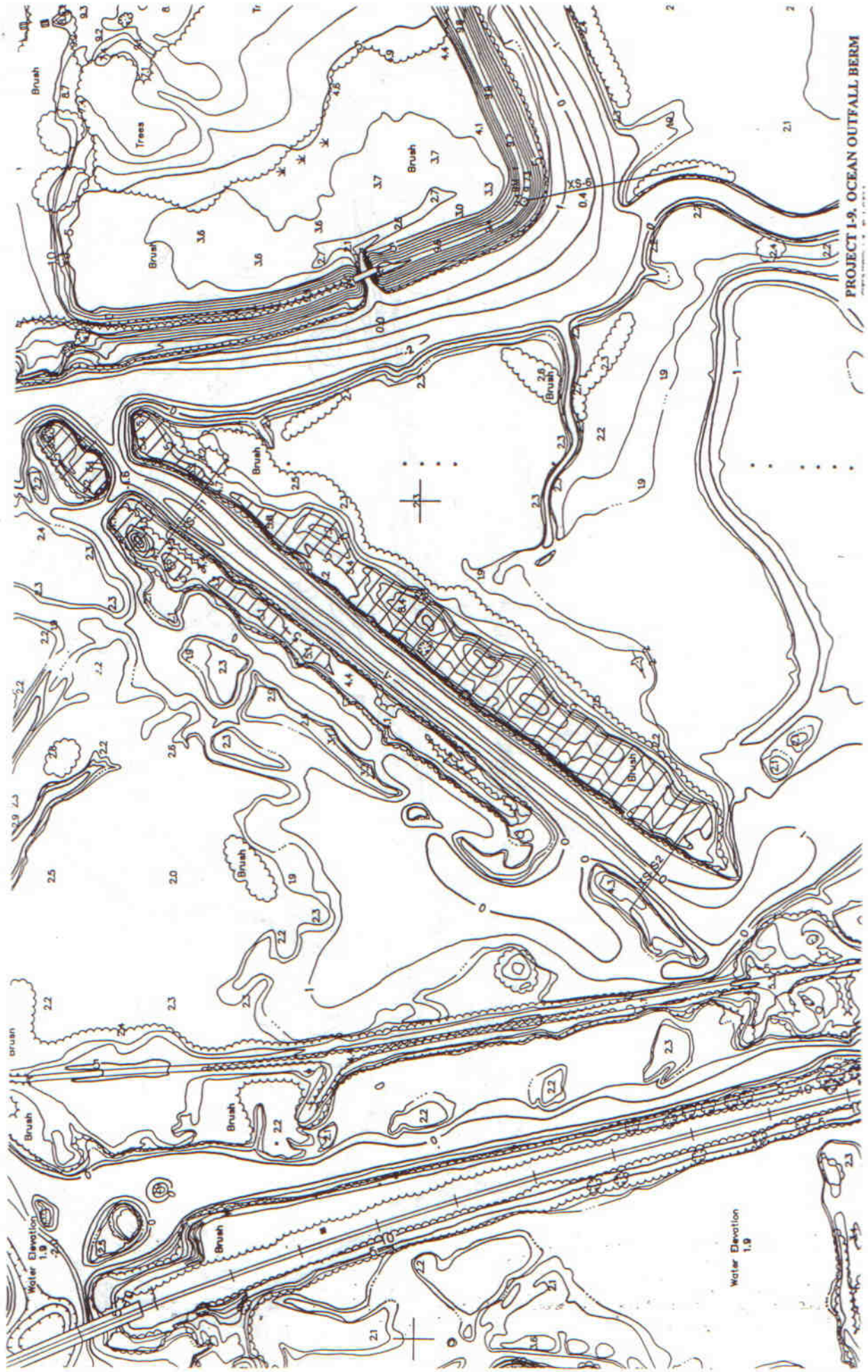

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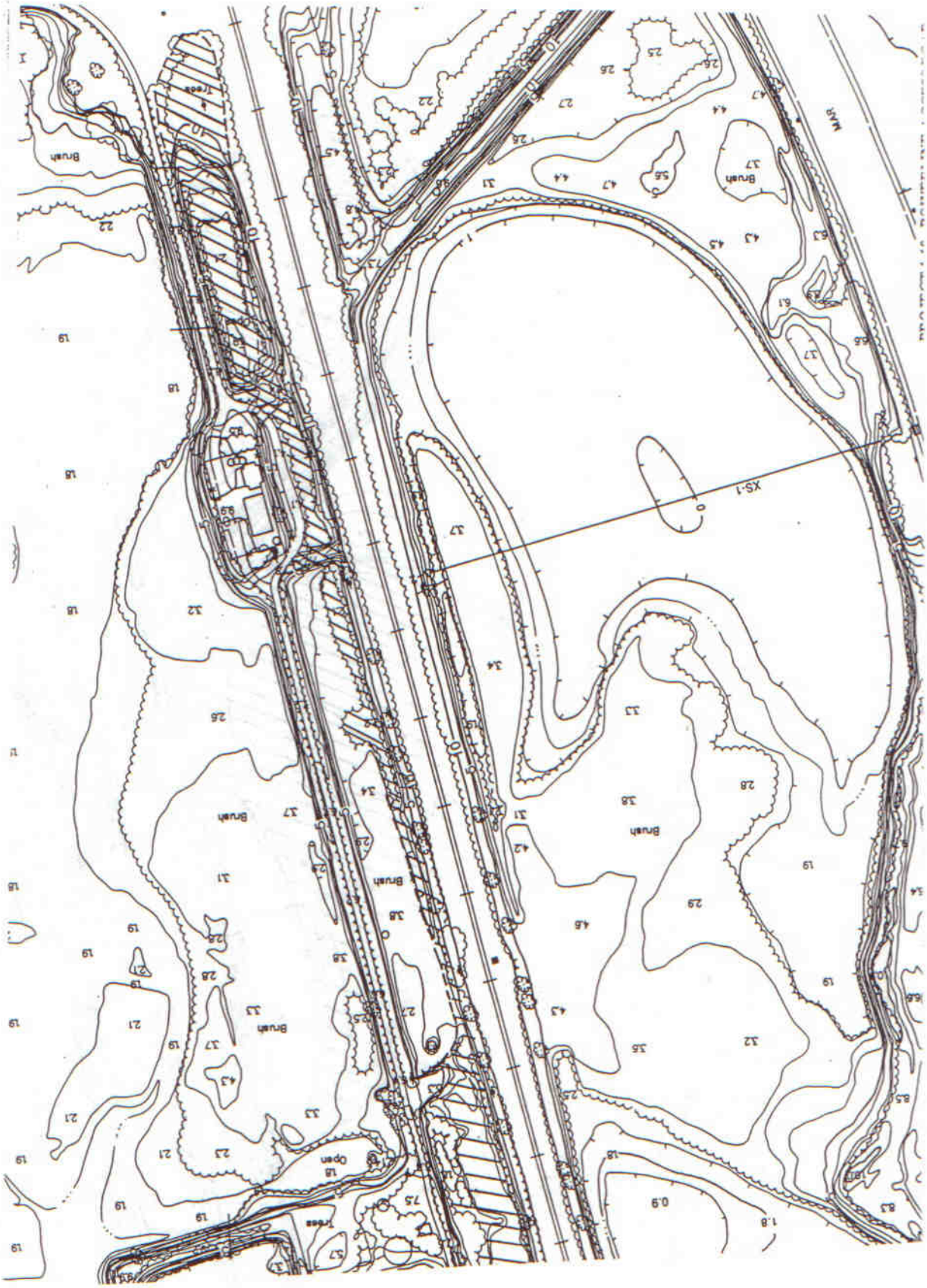

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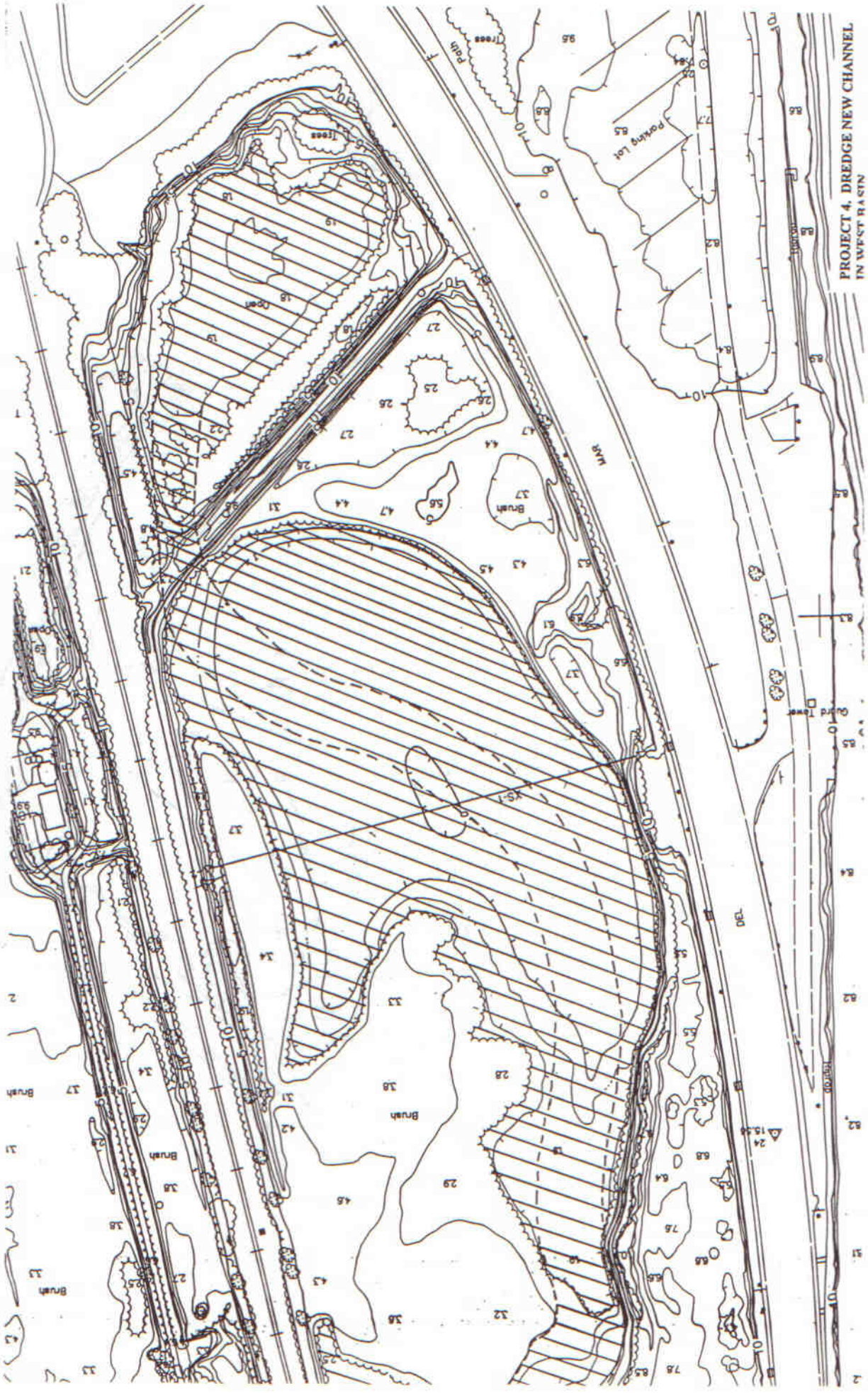

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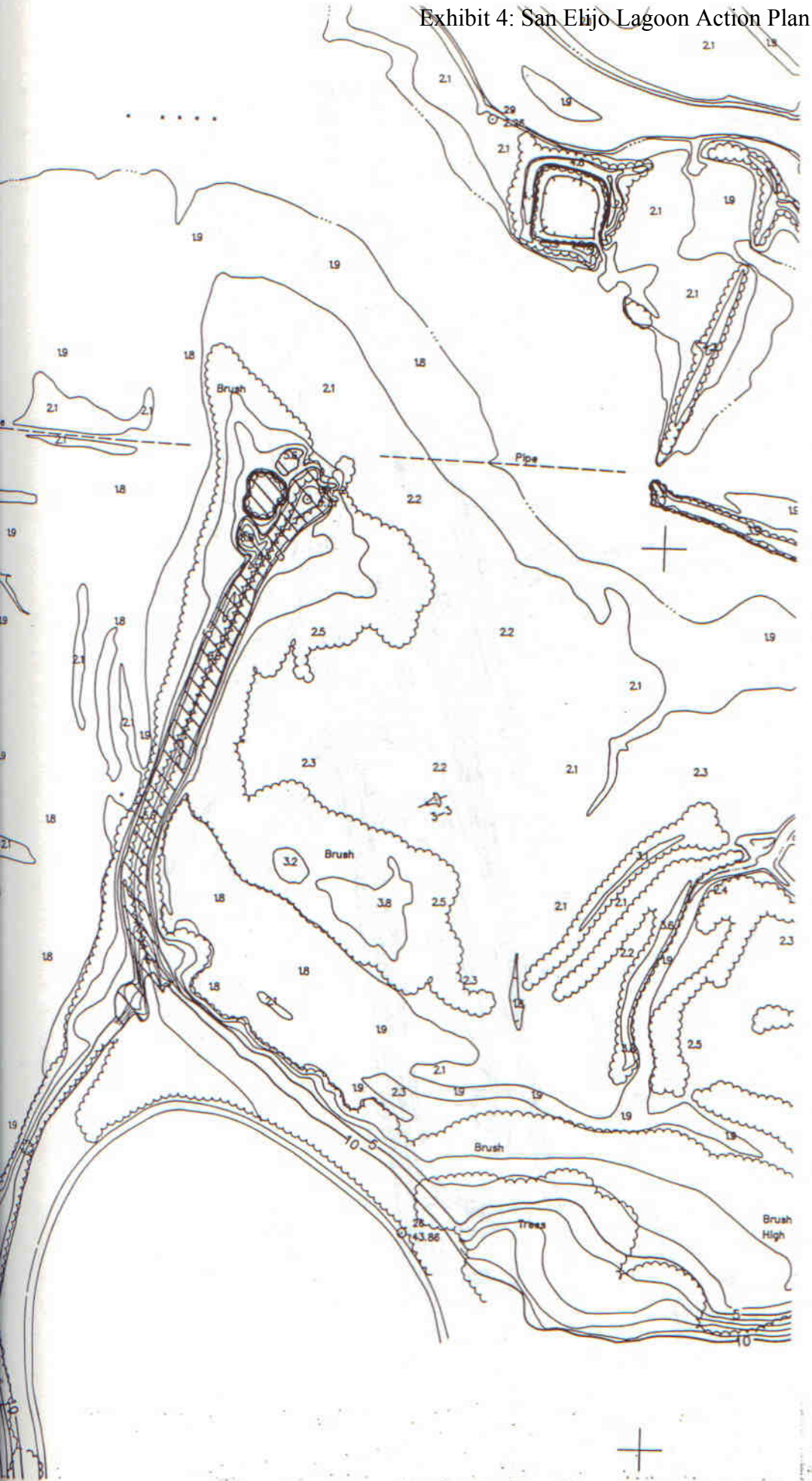

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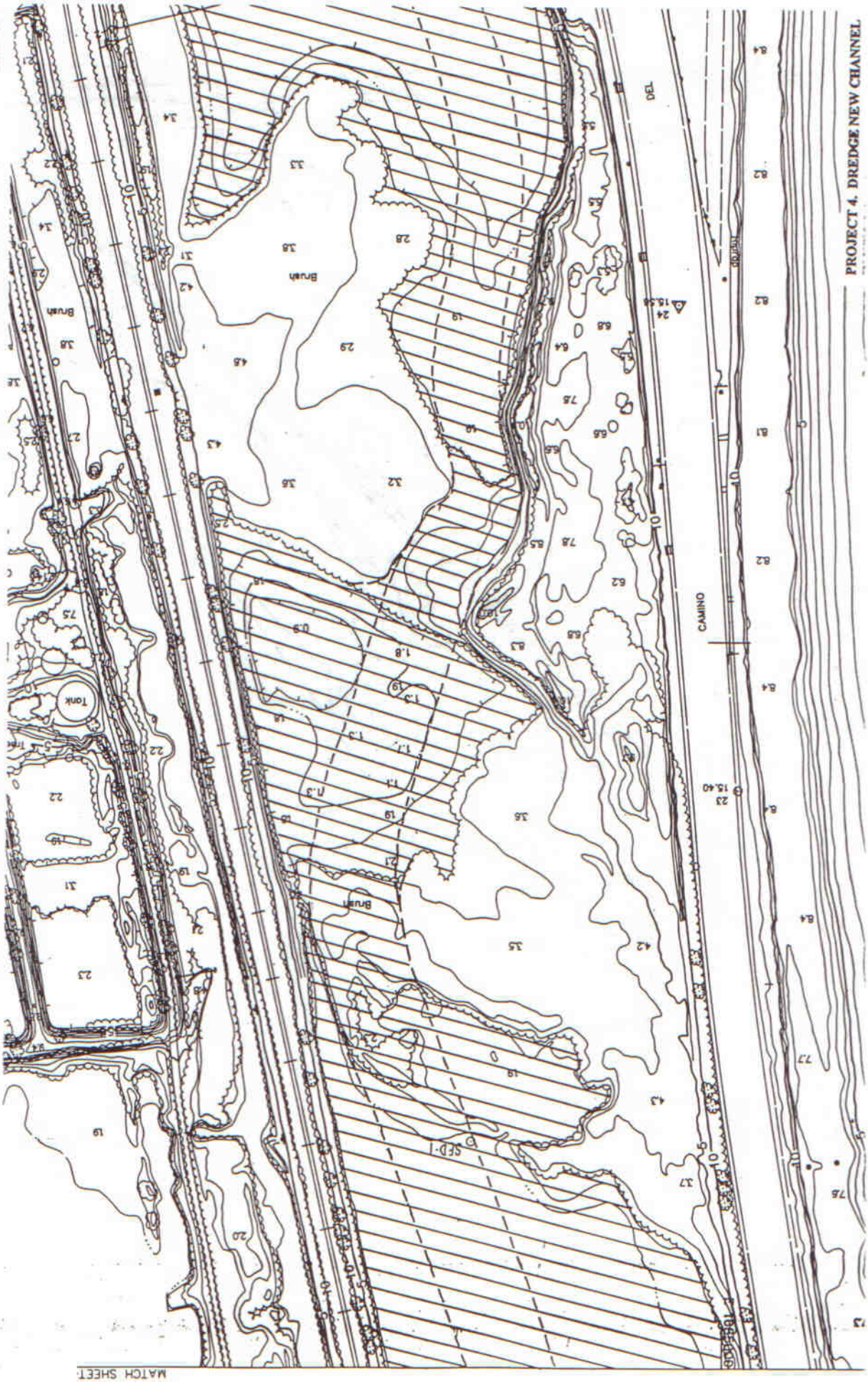

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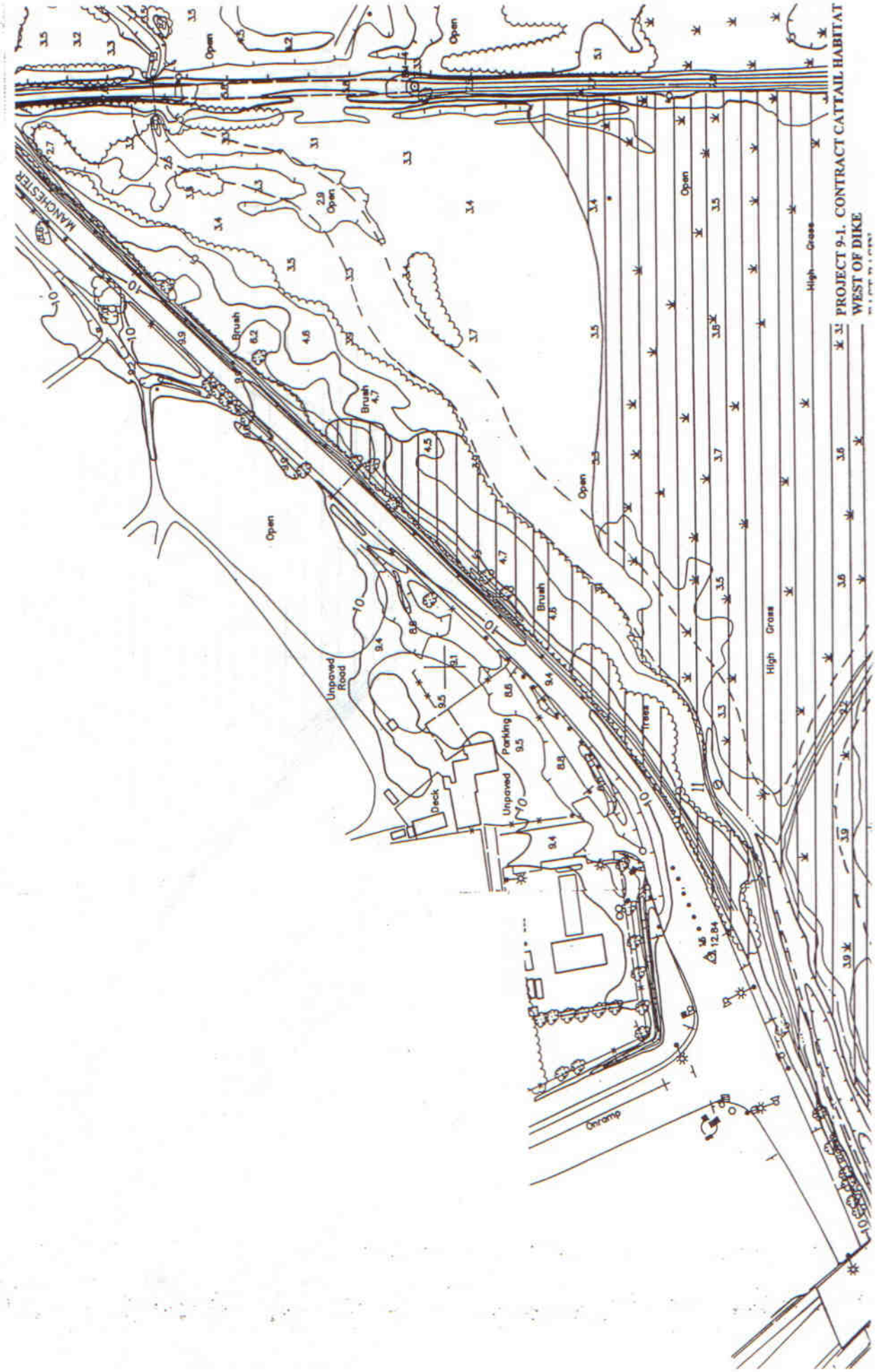

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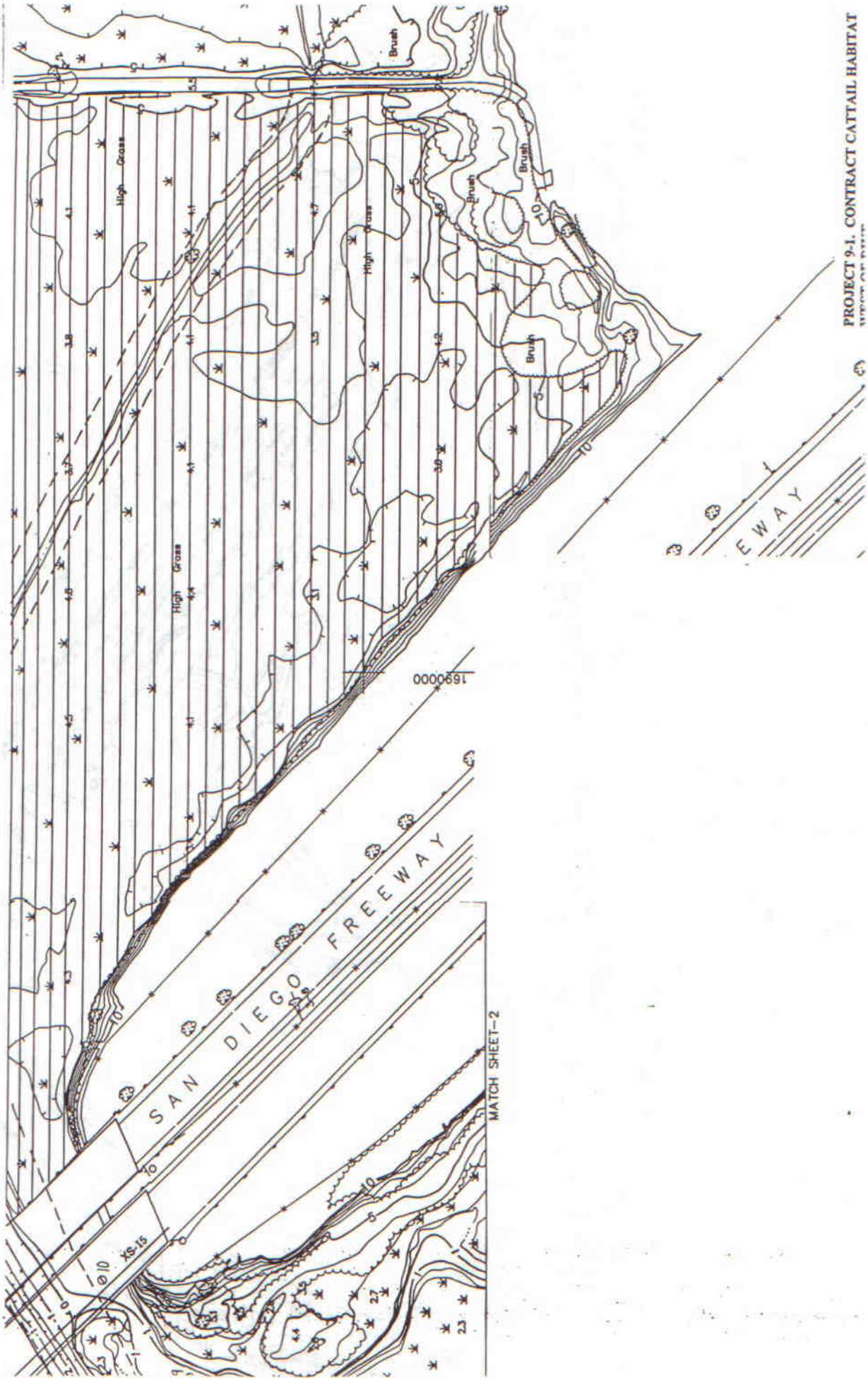

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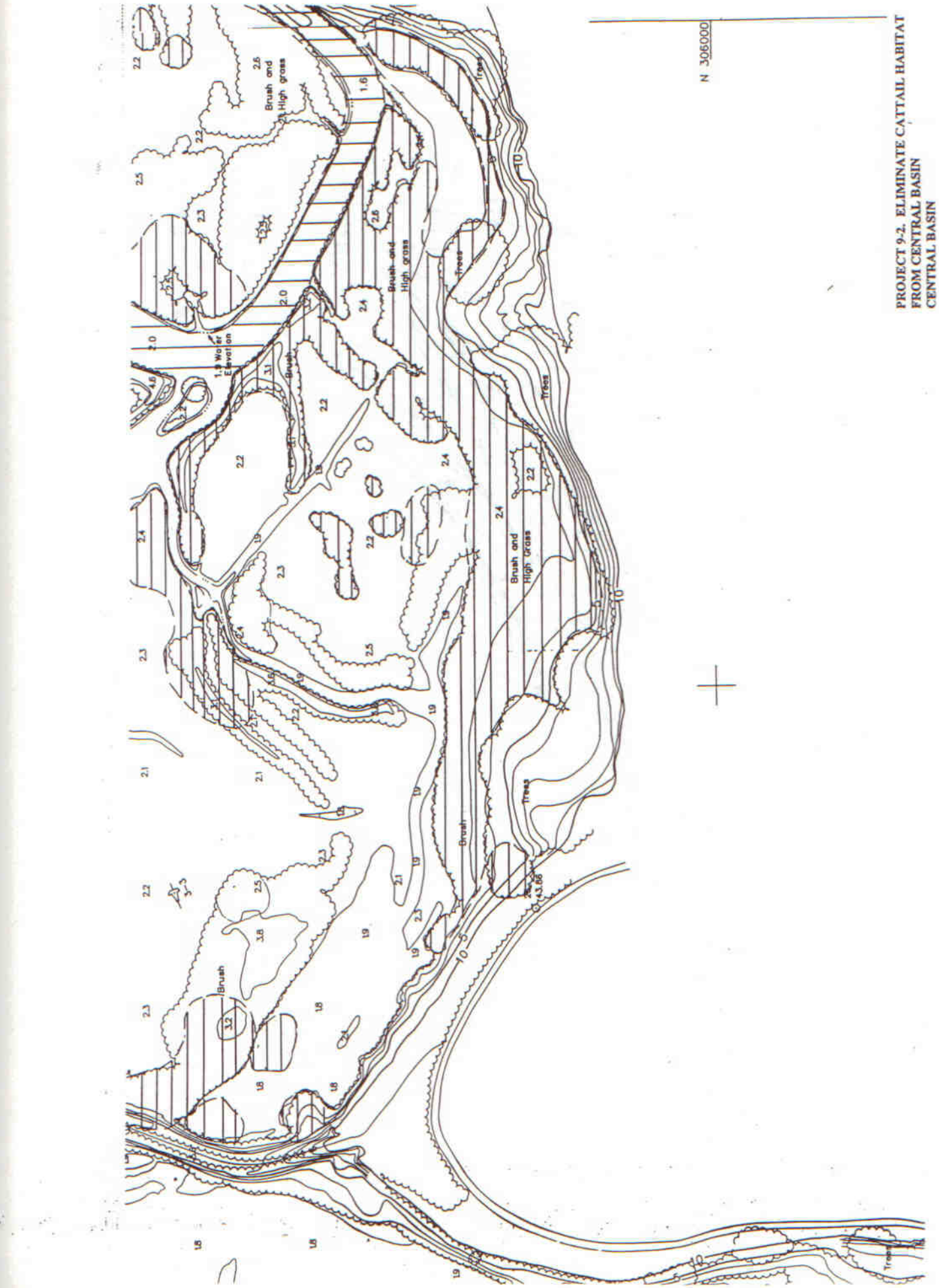

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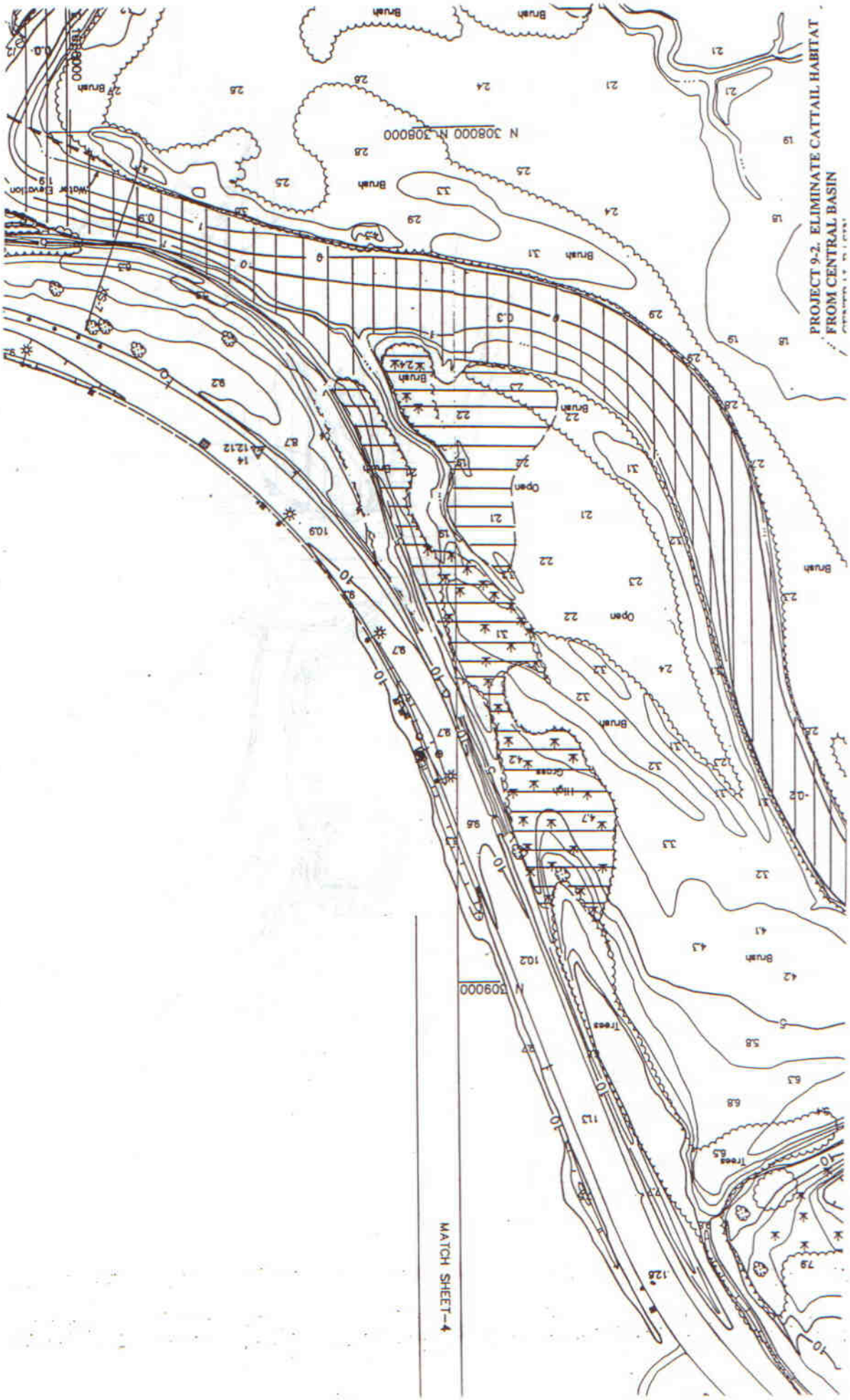

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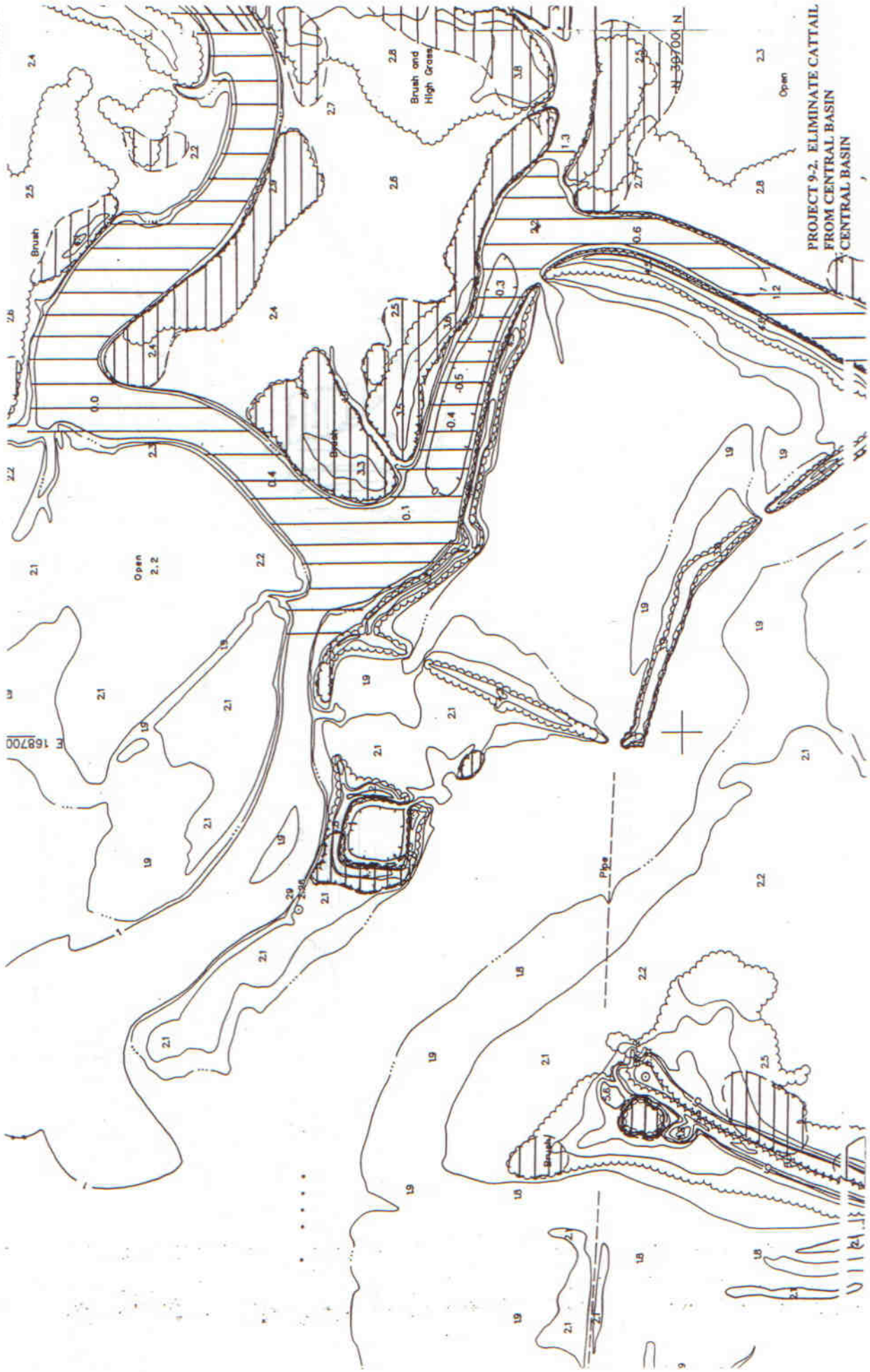

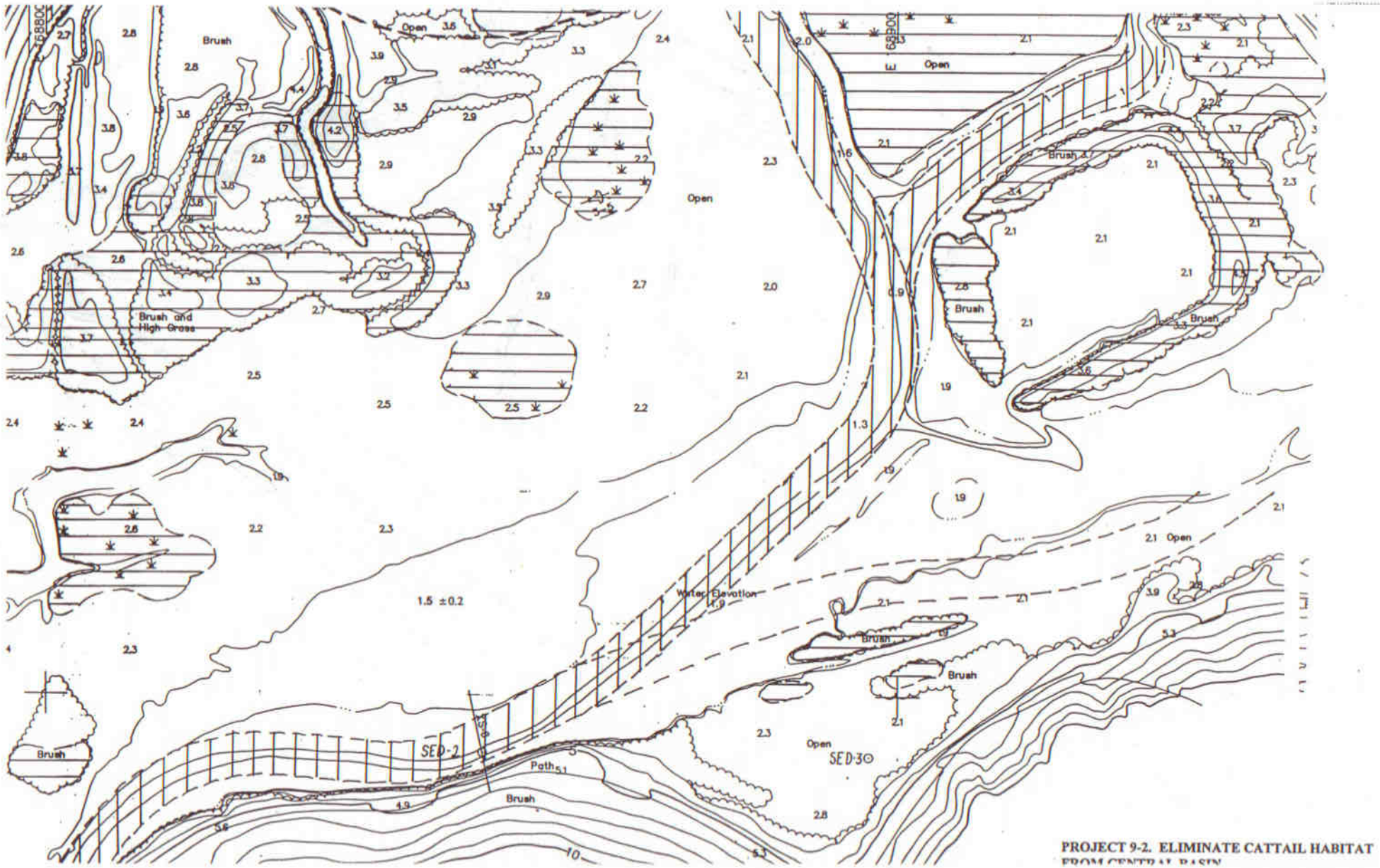

PROJECT 9-2. ELIMINATE CATTAIL HABITAT
FROM CENTRAL BASIN

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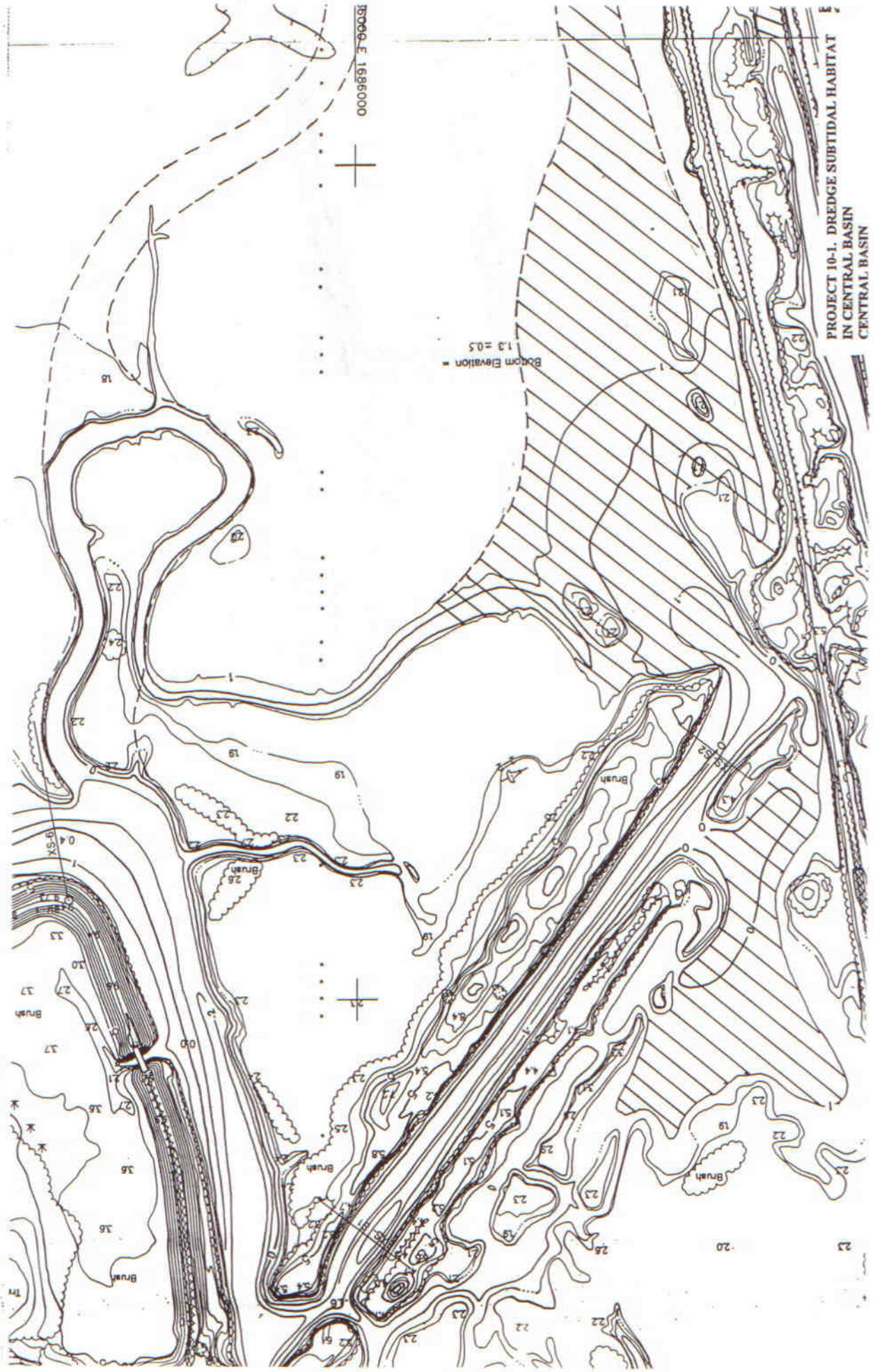

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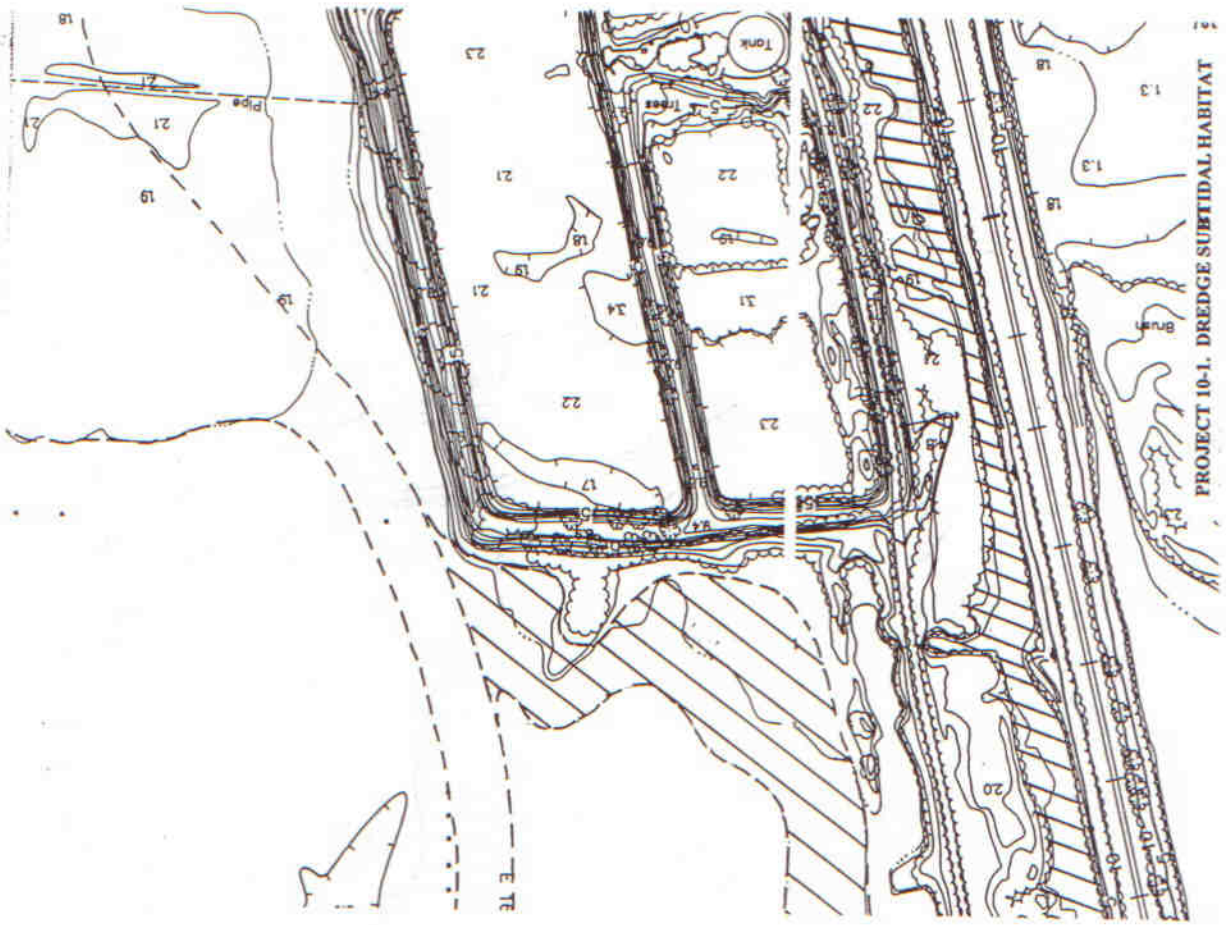

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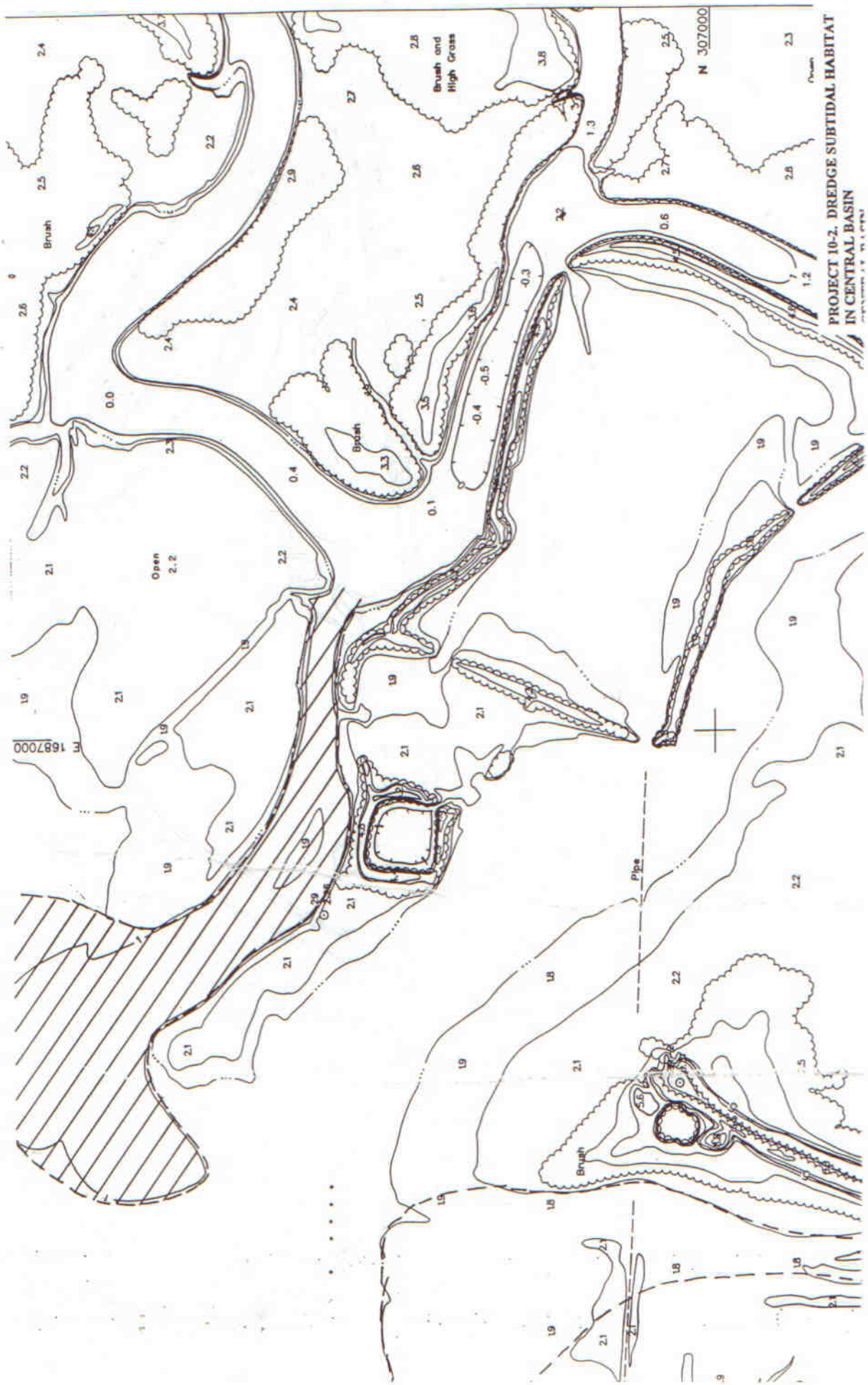

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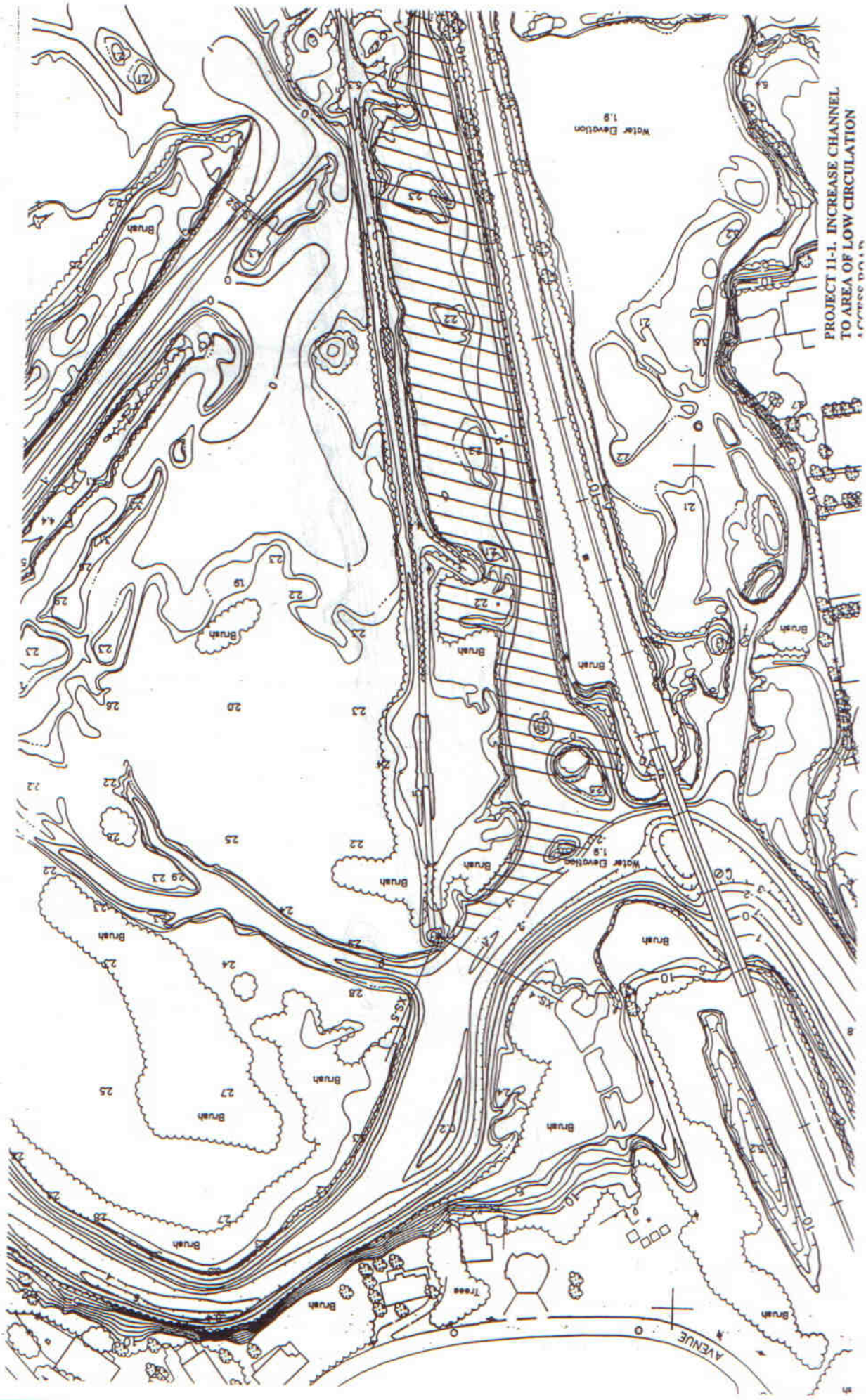

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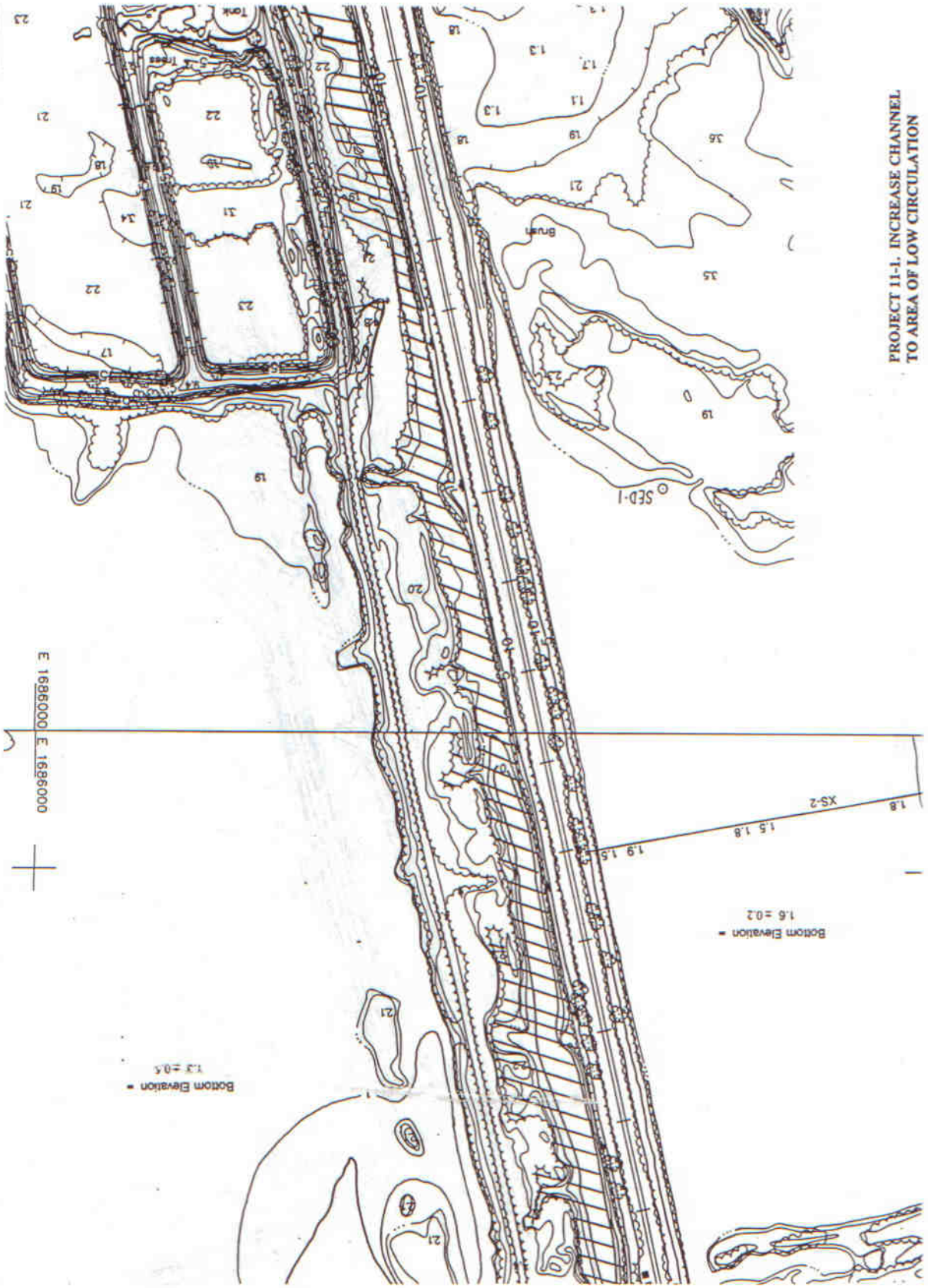

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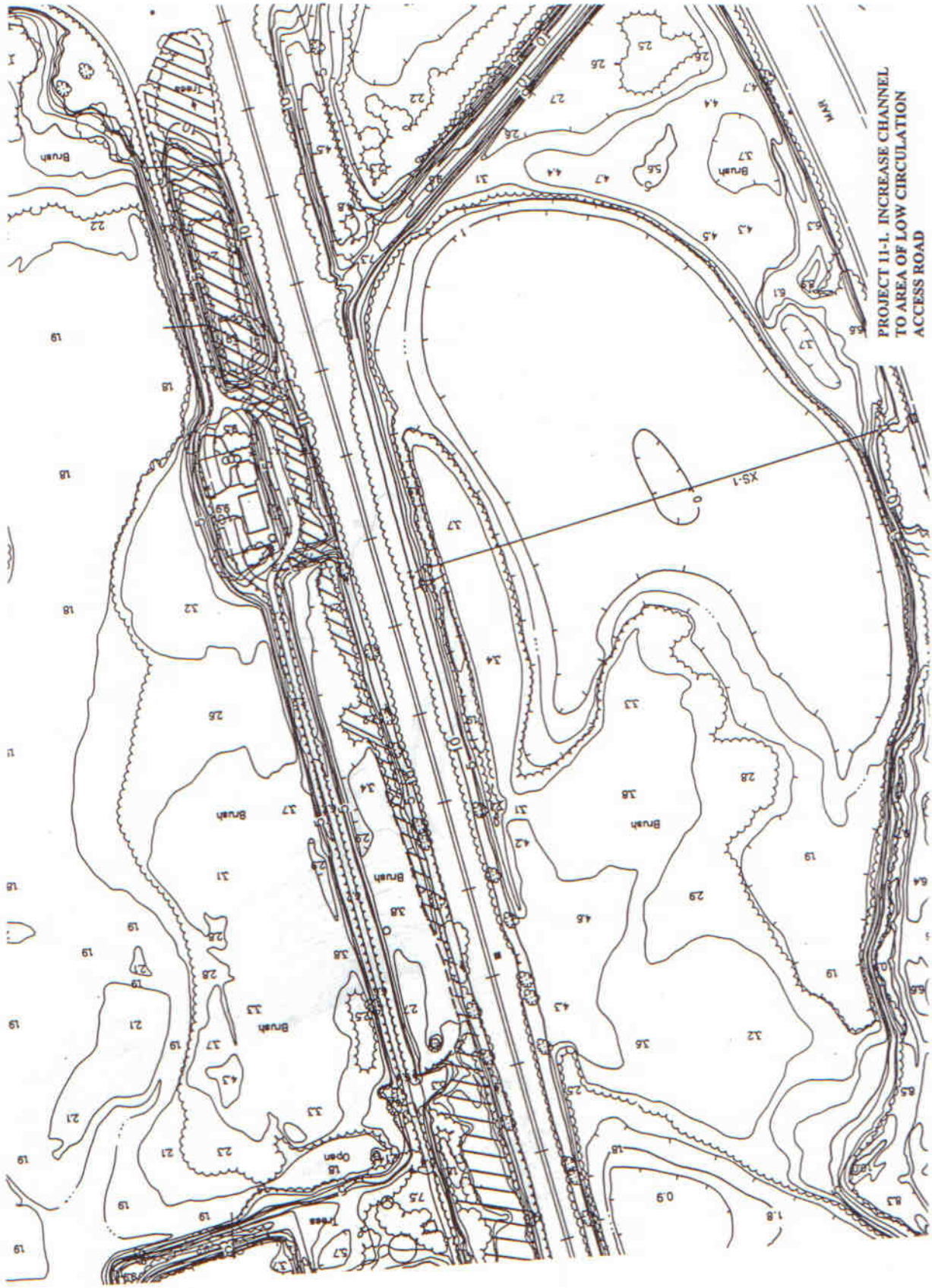

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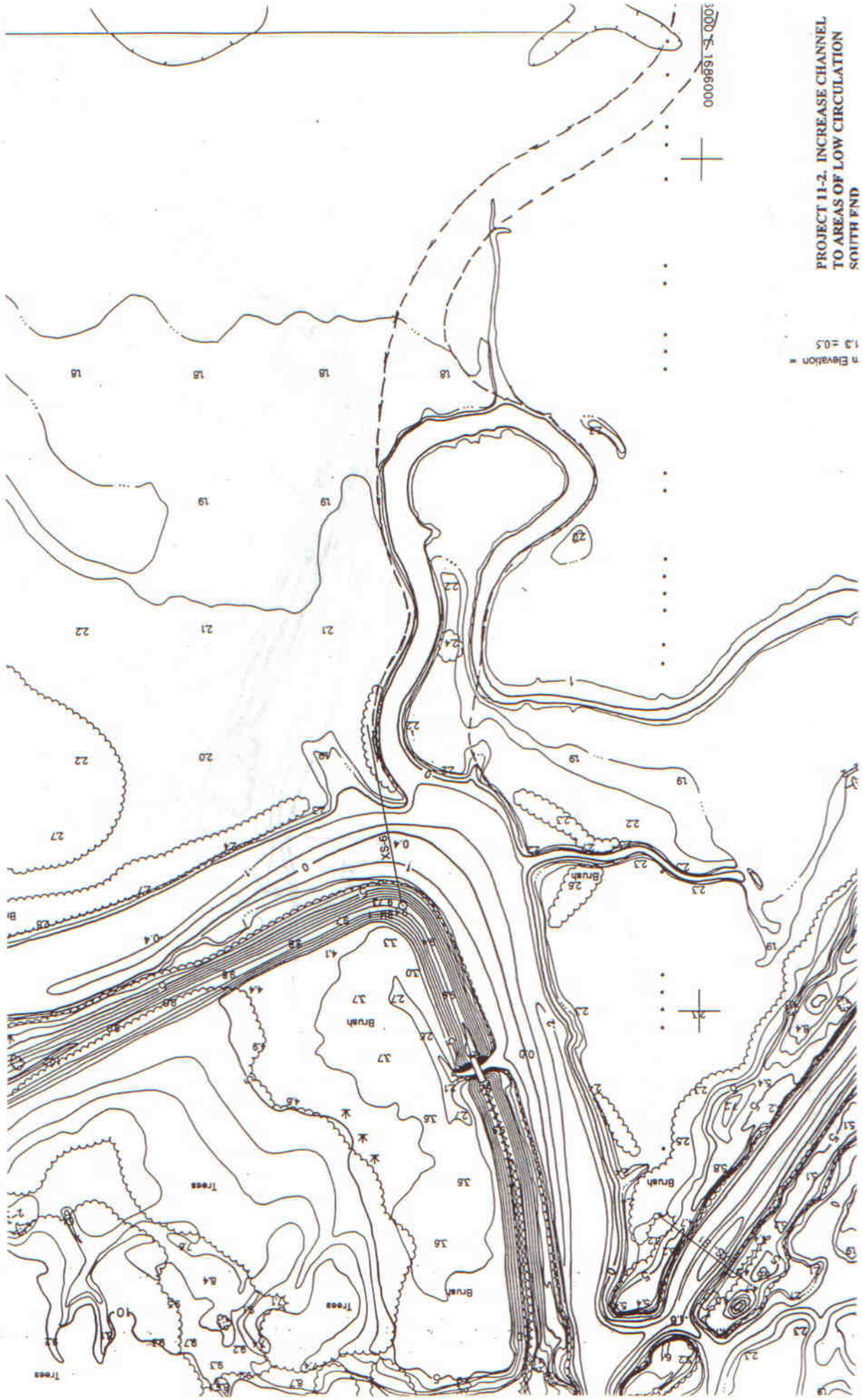

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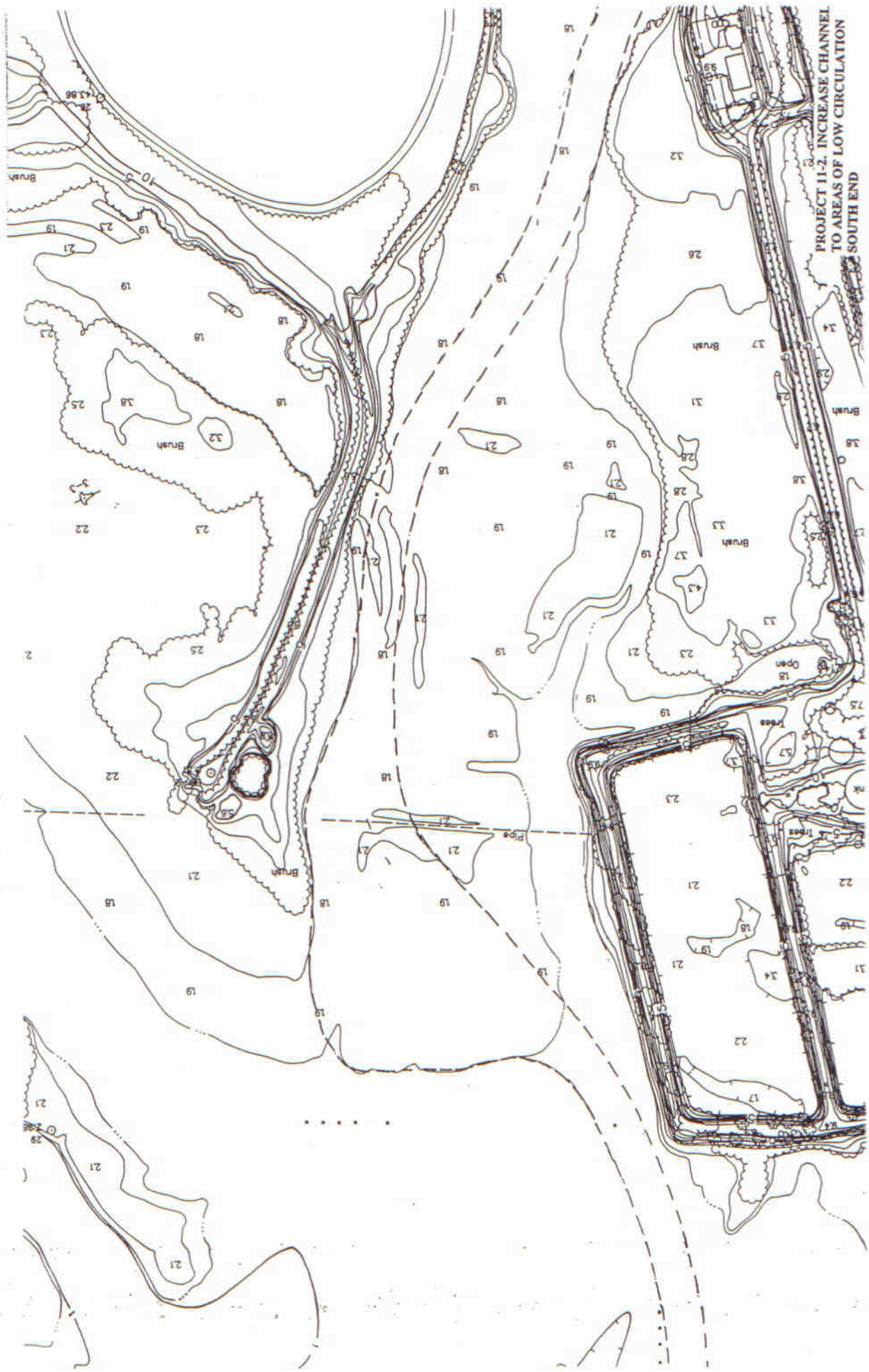

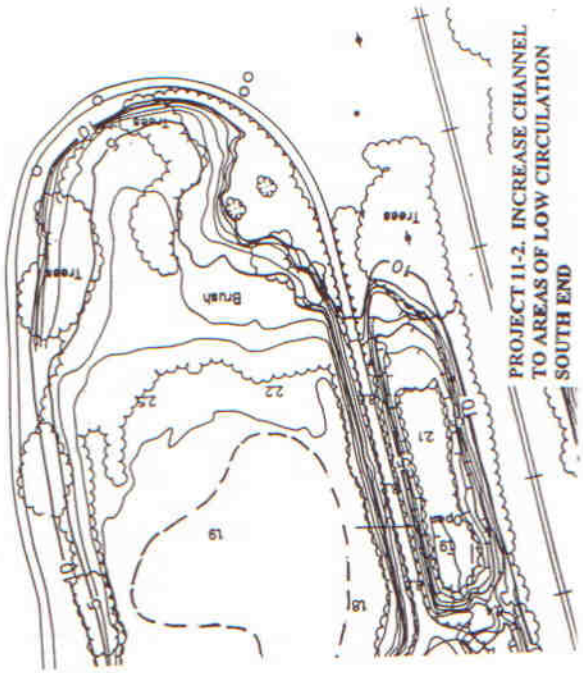
Trees
Brush
22
21
19
18
PROJECT 11-2. INCREASE CHANNEL
TO AREAS OF LOW CIRCULATION
SOUTH END

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Exhibit 4: San Elijo Lagoon Action Plan

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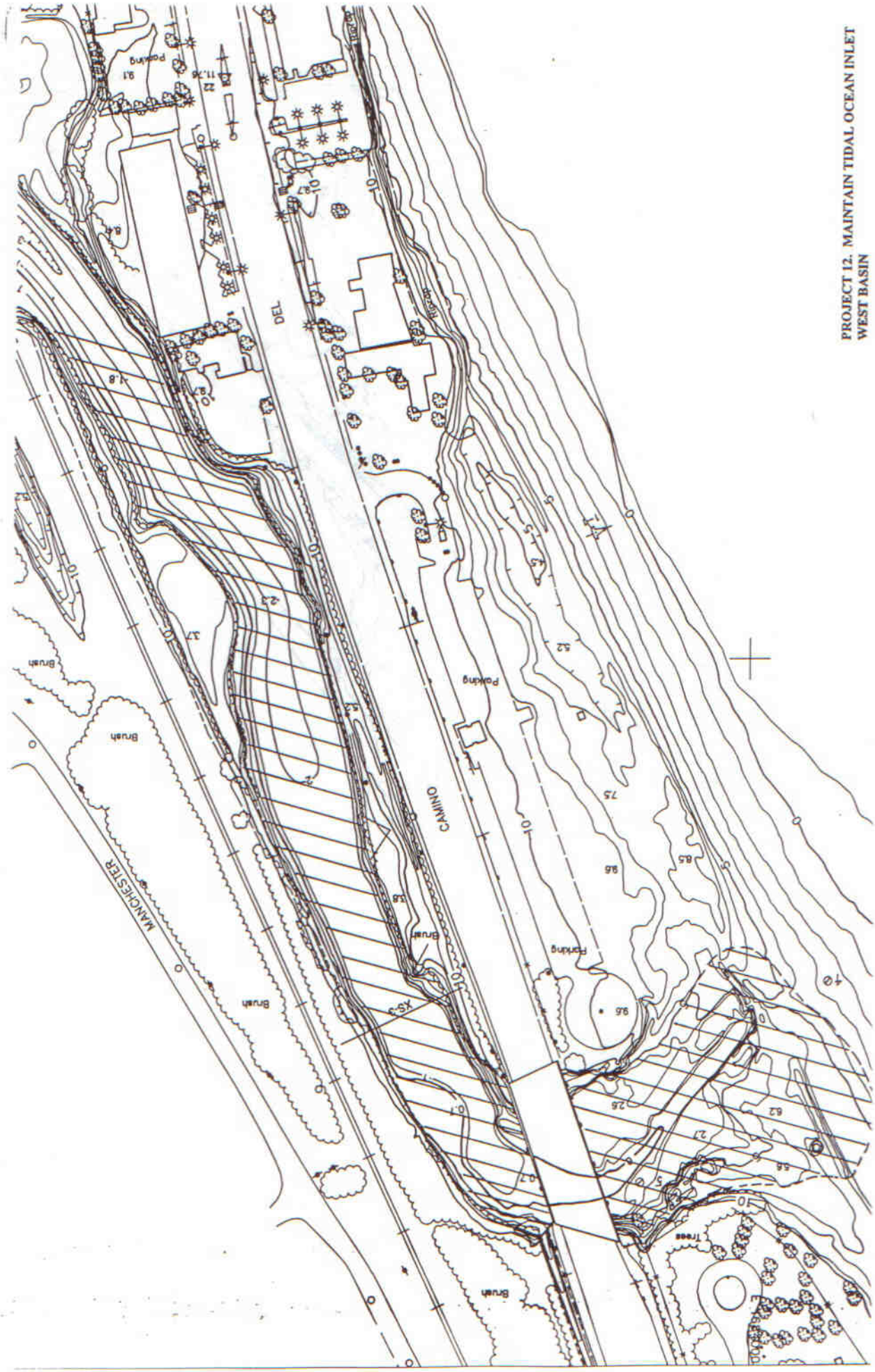

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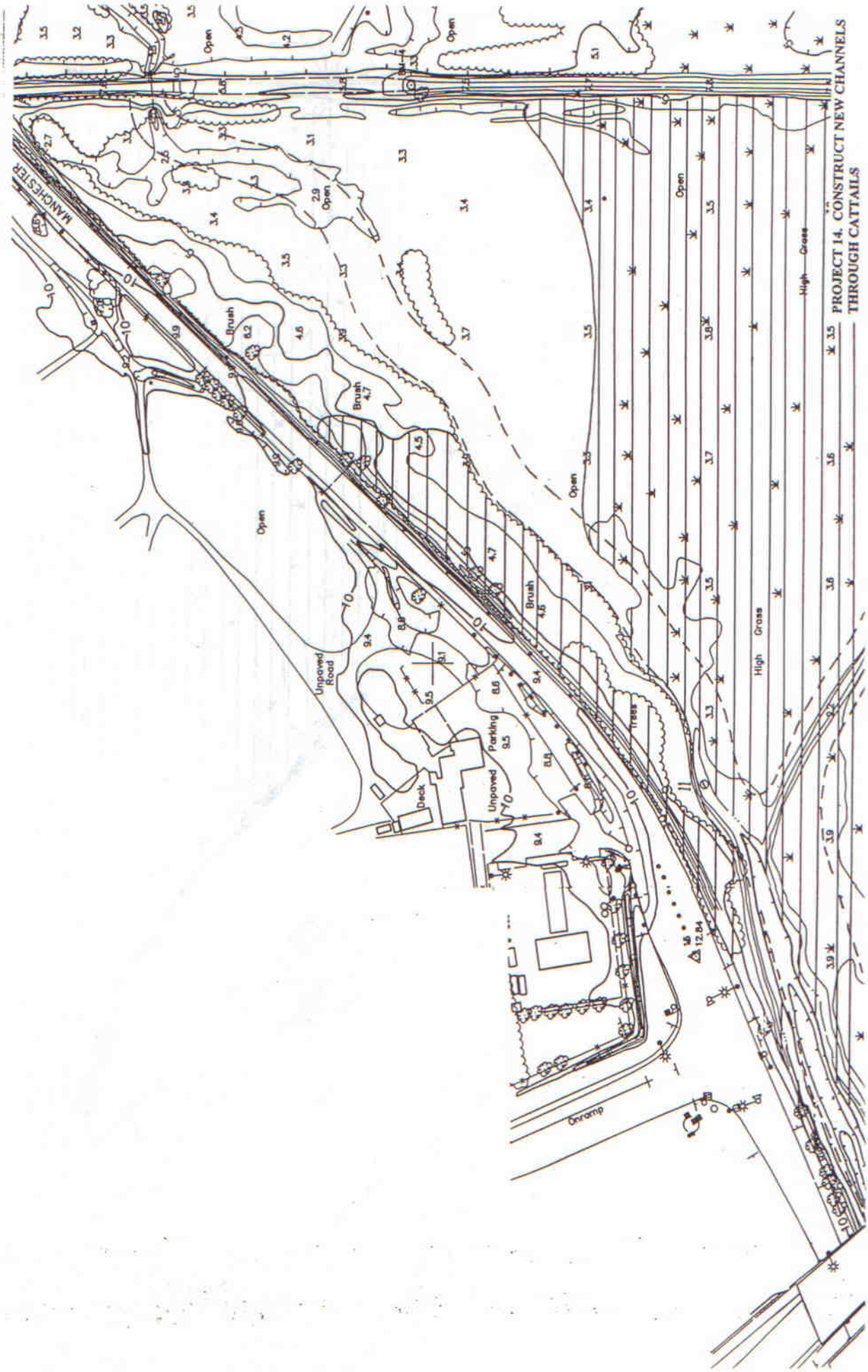

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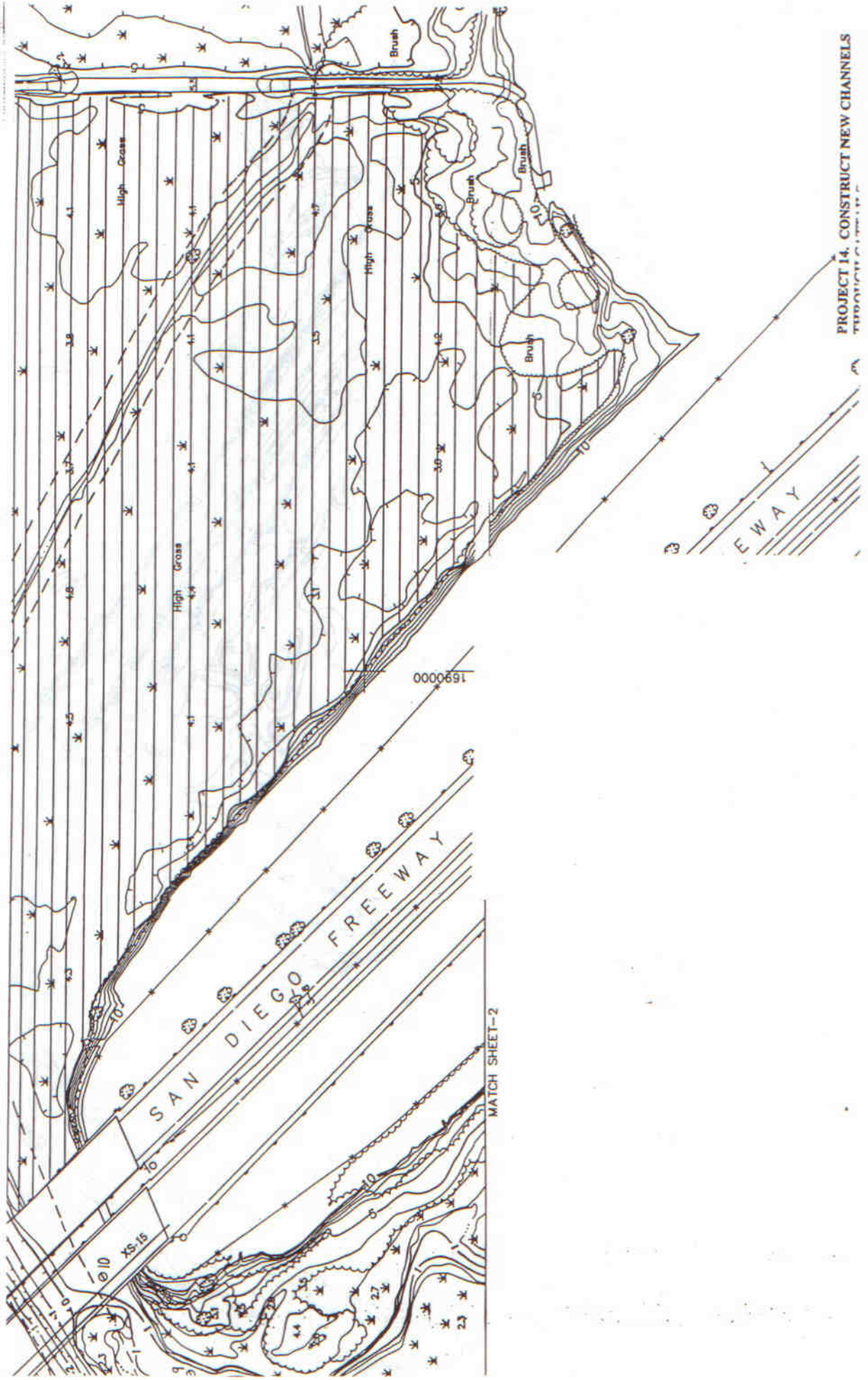

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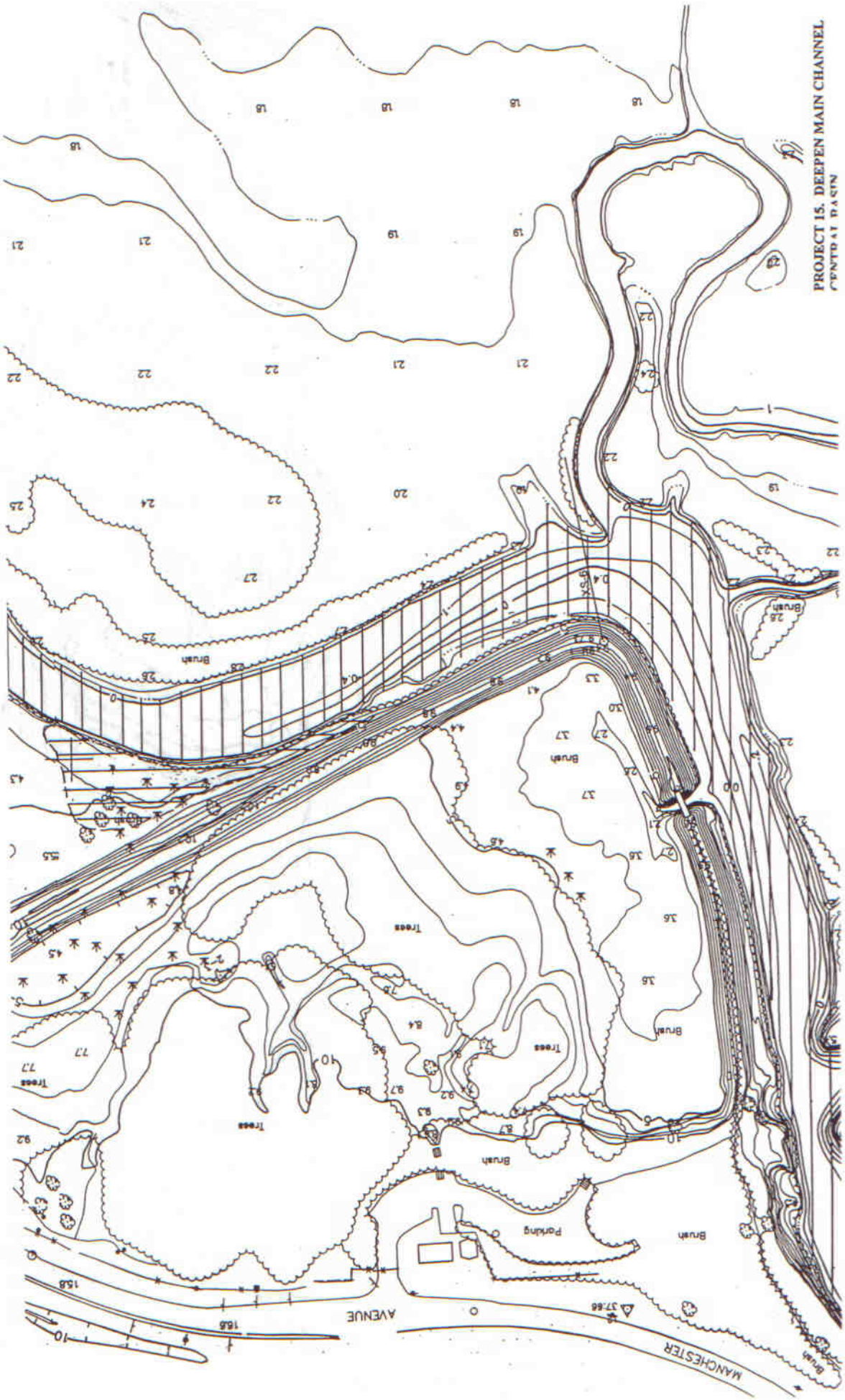

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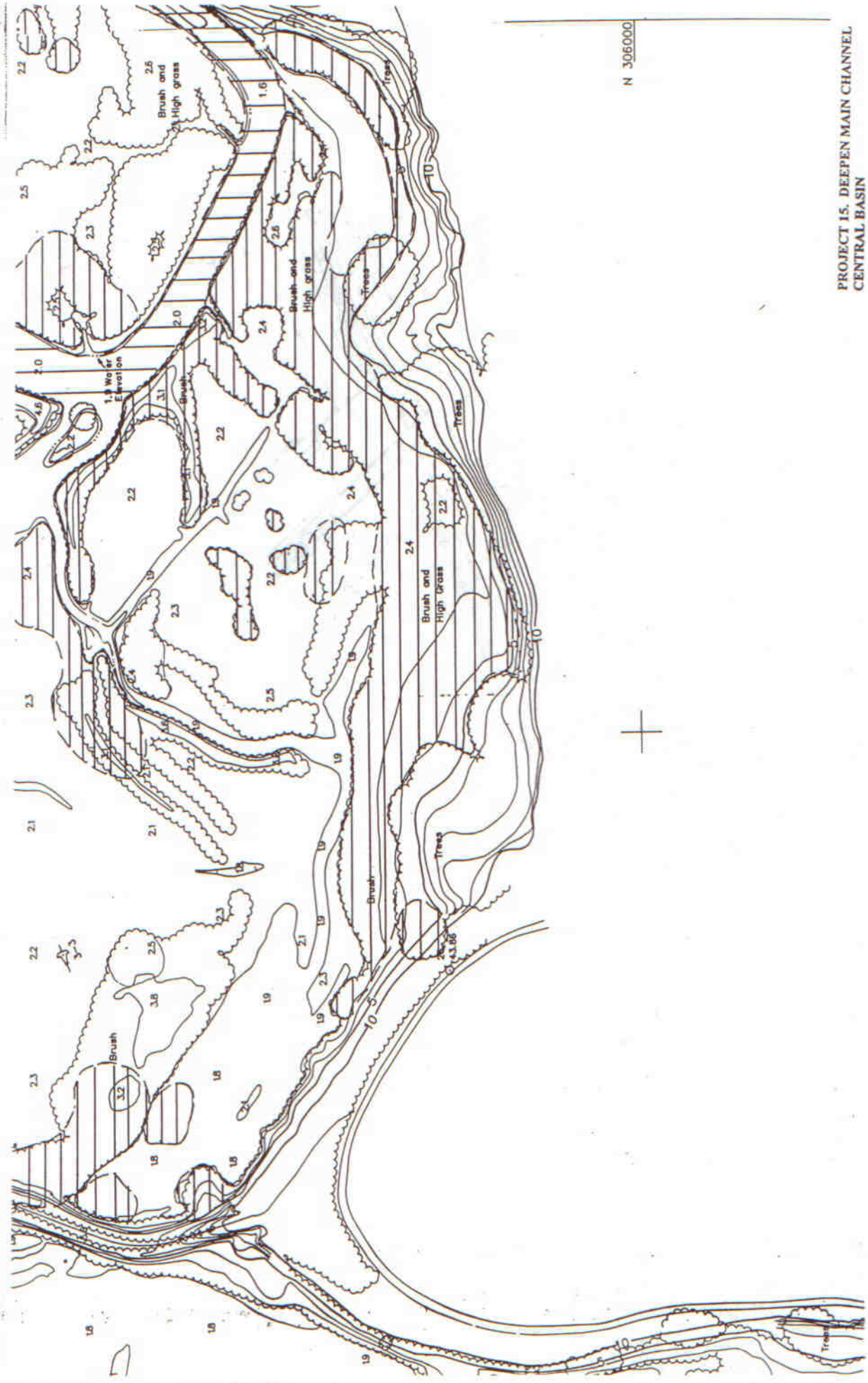

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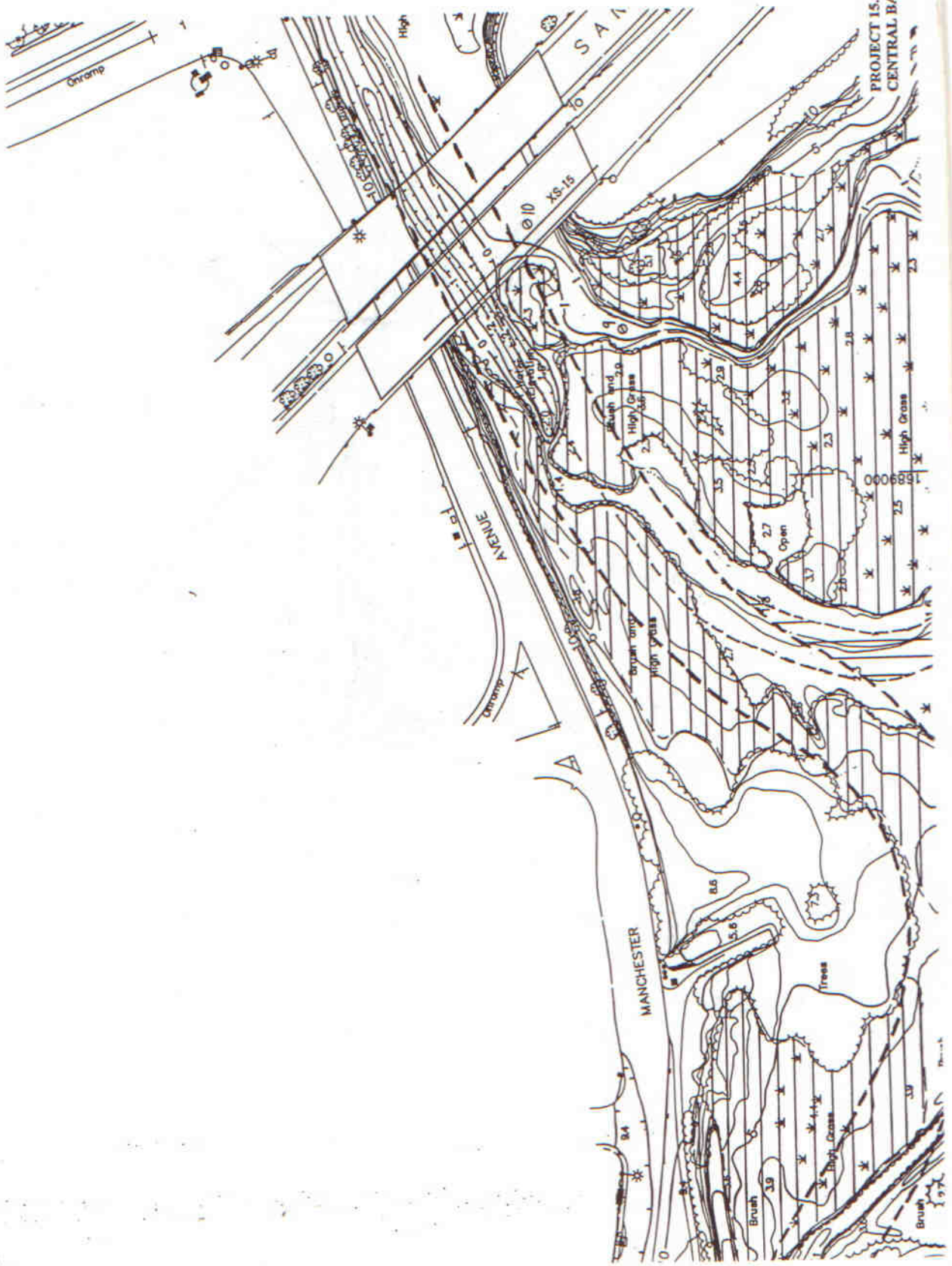

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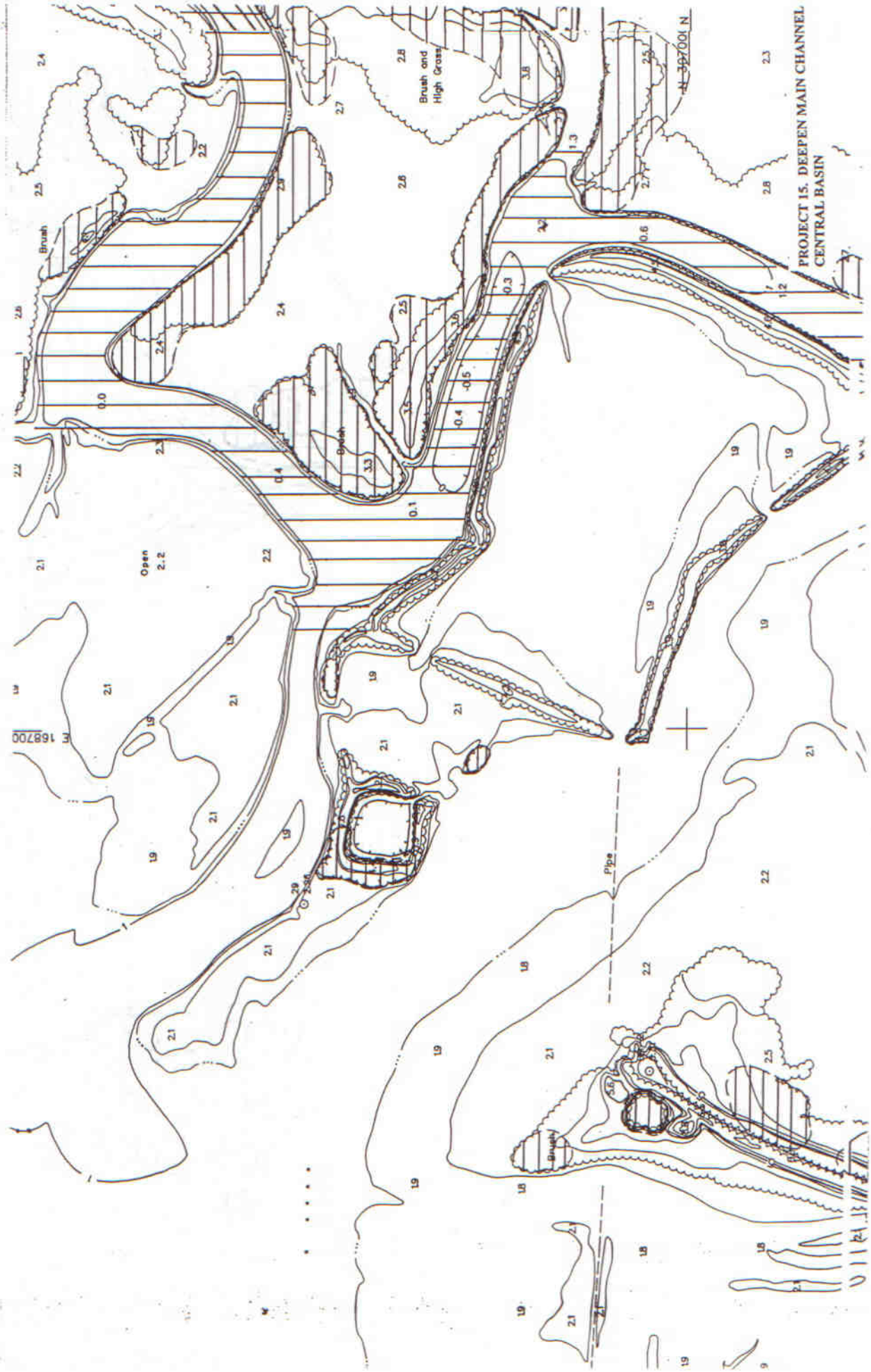

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Exhibit 4: San Elijo Lagoon Action Plan

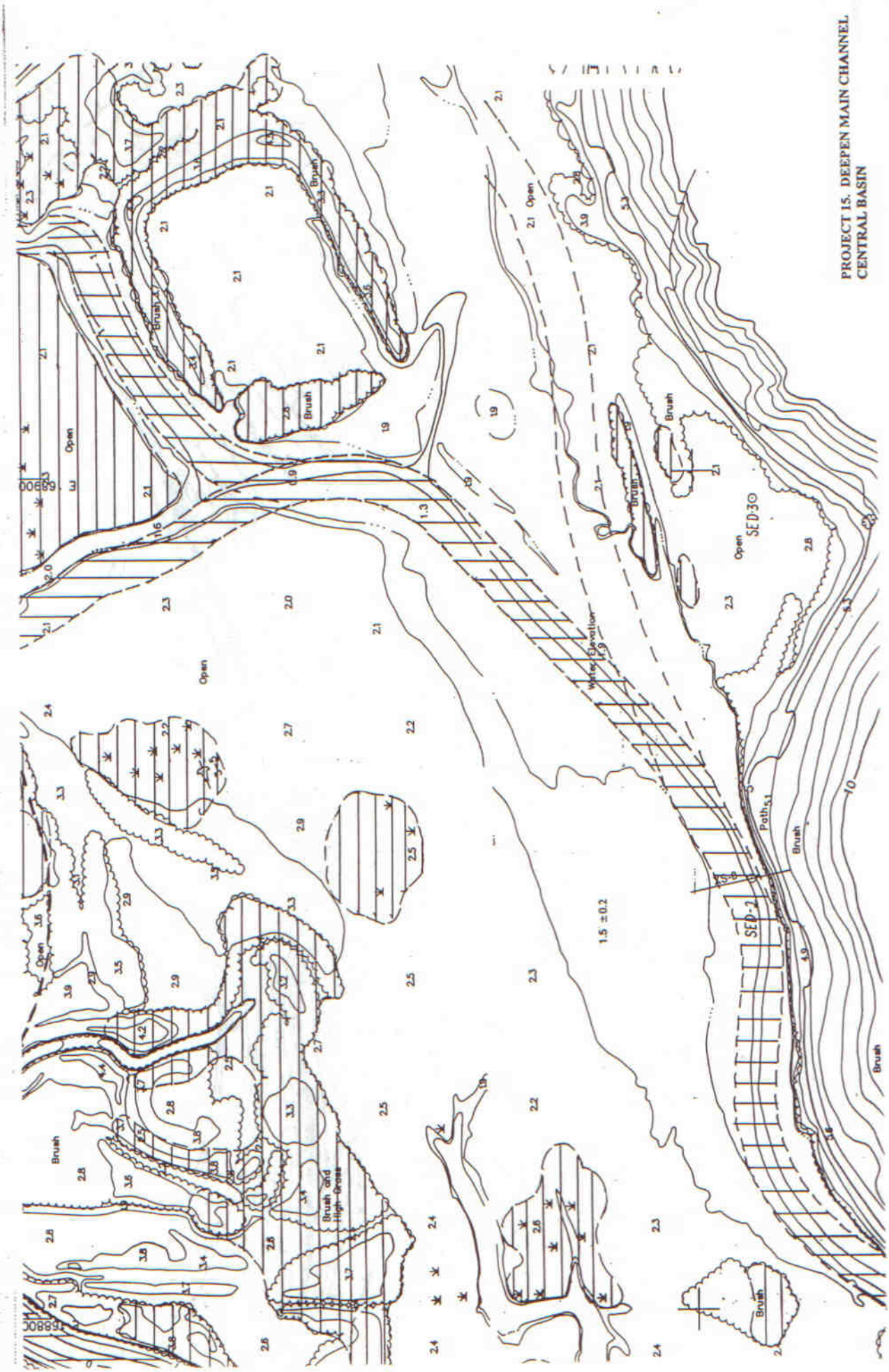

Exhibit 4: San Elijo Lagoon Action Plan

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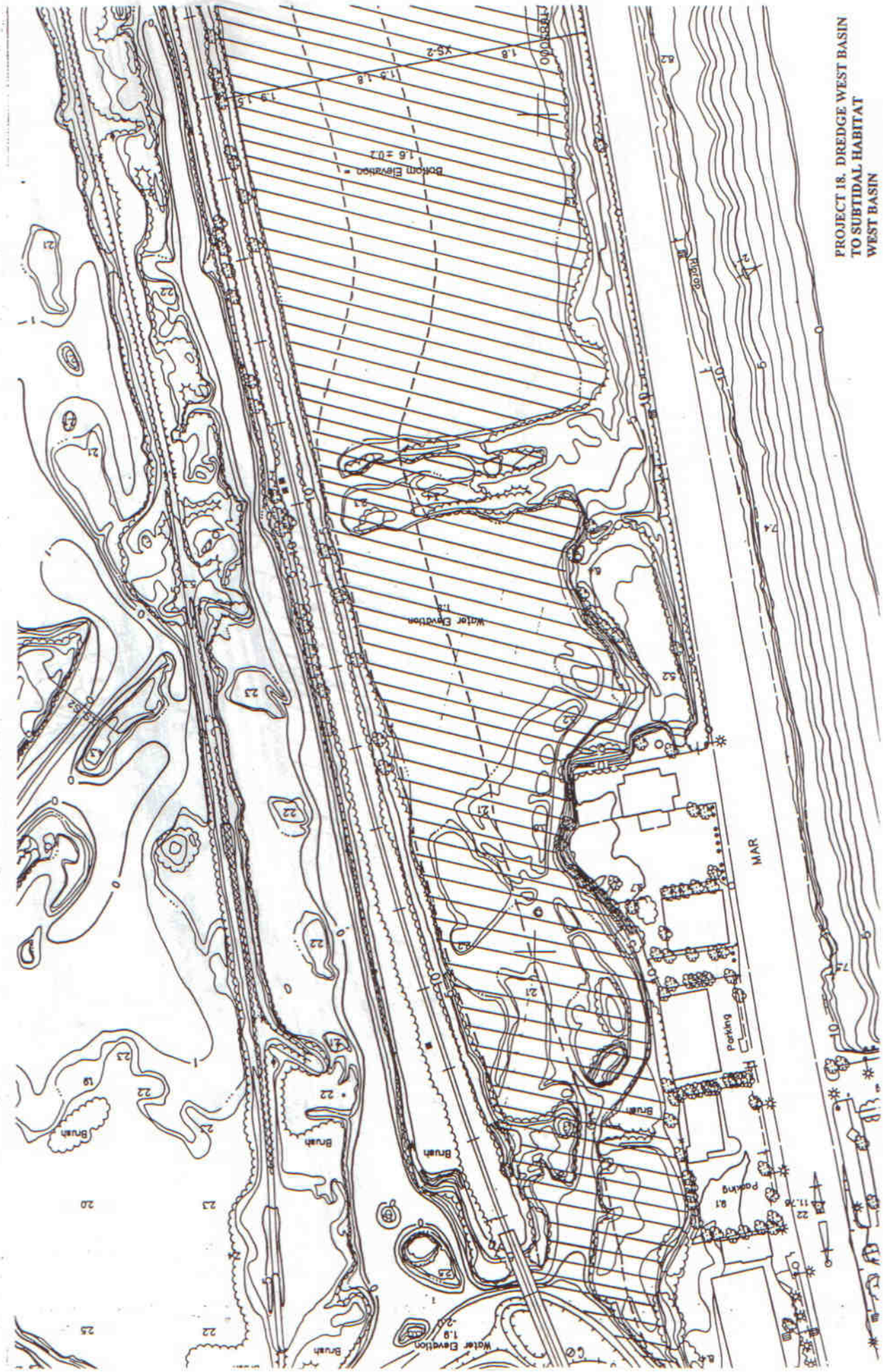

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